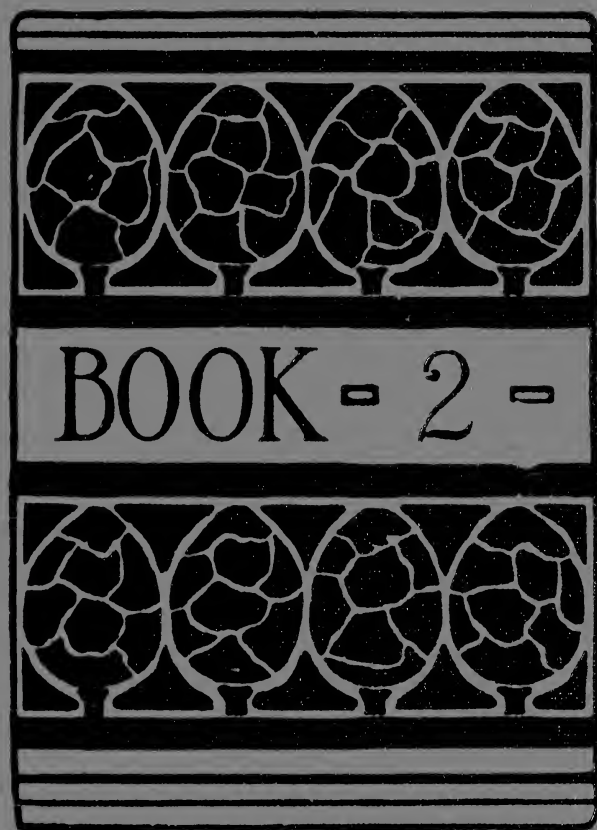
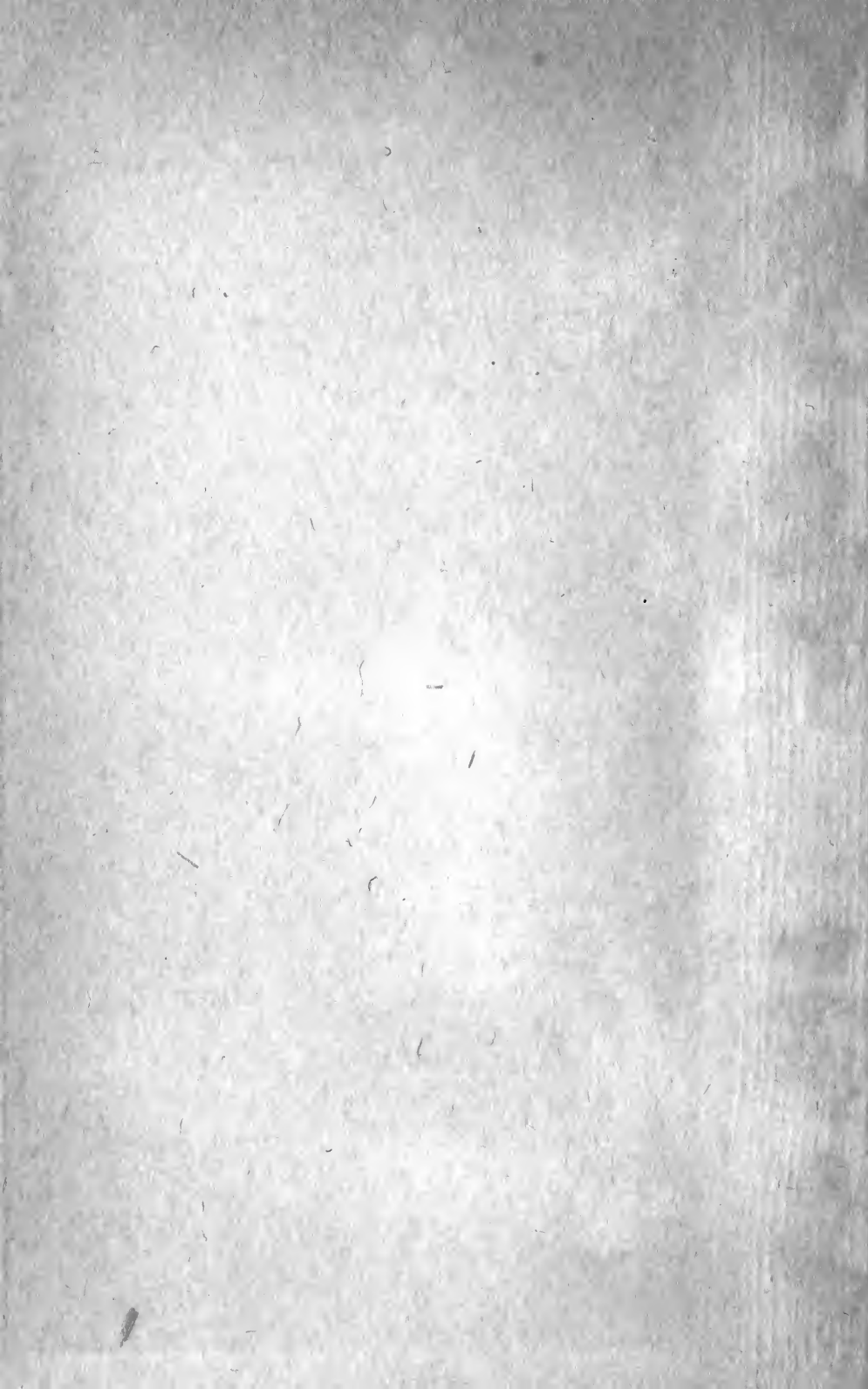
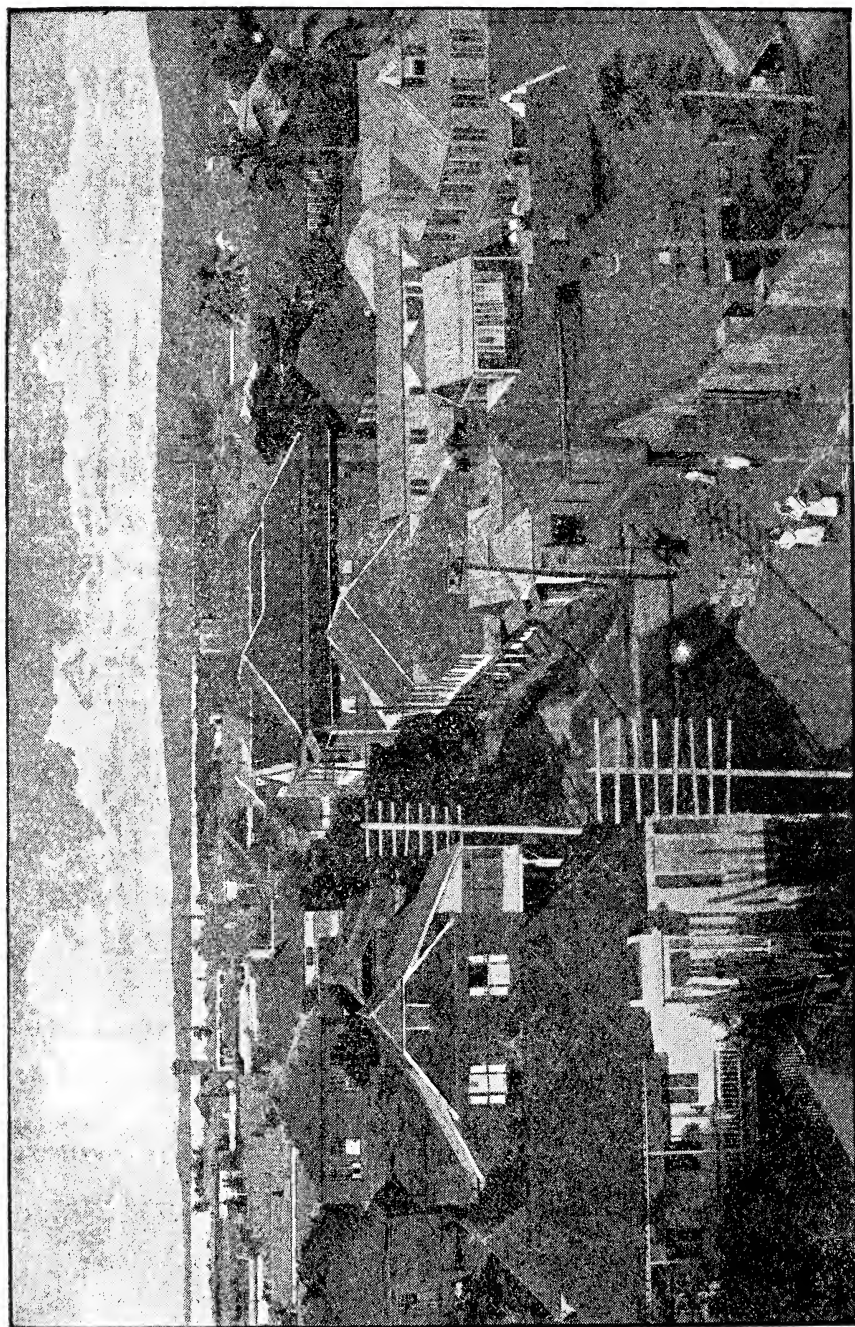


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PUBLISHERS' NOTE

The "Tropical Readers" are designed to interest school children in the familiar objects of the animal and vegetable kingdoms, and to foster habits of observation and reflection. They seek to convey, in a pleasant form, useful information upon plant-life, the cultivation of the soil, and the special treatment under which some of the important vegetable products of the tropics are obtained.

In dealing with the animal kingdom *types* of the principal orders or classes are described in the First Book, preliminary to the elementary study of the *classification* of animals, which appears in the more advanced book.

The Second Book includes, in addition to the subjects enumerated above, a section on "Health", dealing with foods, digestion, clothing, ventilation, and other conditions of healthy living; and a section on "Government".

The language and diction are simple. As far as possible difficult words have been avoided, especially in the first book, in order that the children may be free to fix attention on the facts brought under notice. Many of the chapters are written in dialogue—an attractive form for young children, and the one most helpful in securing a natural and expressive tone in reading.



CONTENTS

PART I.—ANIMAL LIFE.

| | Page | | Page |
|-------------------------------|------|---------------------|------|
| A Walk with the Naturalist, - | 9 | Reptiles, - - - | 31 |
| Animals with Backbones, - | 12 | Amphibians, - - - | 36 |
| Mammals, - - - | 15 | Fishes.—I., - - - | 39 |
| More about Mammals, - | 21 | Fishes.—II., - - - | 43 |
| Birds.—I., - - - | 25 | Insects.—I., - - - | 46 |
| Birds.—II., - - - | 27 | Insects.—II., - - - | 49 |

PART II.—PLANT-LIFE AND SOILS.

| | | | |
|--|----|-----------------------------------|-----|
| The Parts of a Flower, - - | 53 | How Plants are Reared.—II., - | 77 |
| Flowers and Seeds (Fertiliza- tion).—I., - - - | 56 | How Soils are Formed, - - | 80 |
| Flowers and Seeds (Fertiliza- tion).—II., - - - | 59 | Kinds of Soil, - - - | 83 |
| Seeds and Seedlings.—I., - | 62 | More about the Soil, - - | 87 |
| Seeds and Seedlings.—II., - | 65 | Tillage, - - - | 89 |
| How a Plant Feeds.—I., - | 68 | Drainage, - - - | 92 |
| How a Plant Feeds.—II., - | 71 | How we Rob the Soil, - - | 95 |
| How Plants are reared.—I., - | 74 | How we help to Feed the Plants, - | 99 |
| | | Climate and Plant-life, - - | 101 |
| | | Insect Pests, - - - | 103 |

PART III.—CULTIVATION OF CROPS.

| | | | |
|-------------------------|-----|--|-----|
| A Sugar Plantation, - - | 107 | The Cocoa-nut Palm, - - | 122 |
| Sugar and Rum, - - - | 109 | Tobacco, - - - | 124 |
| Coffee.—I., - - - | 113 | Logwood, - - - | 128 |
| Coffee.—II., - - - | 115 | Corn, - - - | 131 |
| The Coffee-beans - - - | 117 | Coco (<i>Colocasia esculenta</i>), - | 134 |
| The Banana, - - - | 120 | | |

PART IV.—HEALTH.

| | | | |
|--------------------------|-----|----------------------------|-----|
| Why we Eat, - - - | 136 | A few Common Foods, - - | 147 |
| Heat-giving Foods, - - | 140 | The Best Kind of Diet, - - | 150 |
| Flesh-forming Foods, - - | 144 | Water.—I., - - - | 153 |

| | Page | | Page |
|-----------------------------|------|--------------------------------|------|
| Water,—II., - - - | 156 | The Clothes we Wear, - - | 174 |
| Other Beverages, - - - | 160 | Soil and Climate; or, Where to | |
| What becomes of our Food, - | 163 | Live.—I., - - - | 178 |
| The Air we Breathe, - - | 166 | Soil and Climate; or, Where to | |
| Why the Wind Blows, - - | 169 | Live.—II., - - - | 181 |
| Ventilation, - - - | 171 | | |

PART V.—GOVERNMENT.

| | | | |
|---|-----|---------------------------------|-----|
| Why Laws are made, - - | 184 | Public Departments and Offices. | |
| The Legislative Council of | | —II., - - - | 195 |
| Jamaica, - - - | 186 | The Courts of Justice, - - | 197 |
| The Governor, - - - | 188 | Public Gardens and Planta- | |
| Government in the Parishes, - | 191 | tions, - - - | 199 |
| Public Departments and Offices. | | Army, Navy, and Volunteers, - | 203 |
| —I., - - - | 192 | | |
| Summary, - - - | 209 | | |
| General View of the Animal Kingdom, - - | 234 | | |
| List of the more Difficult Words and Phrases, - - | 236 | | |

SECOND BOOK

PART I.—ANIMAL LIFE

A WALK WITH THE NATURALIST.

1. Mr. Johnson lived in a pleasant house some distance beyond the noise and bustle of Kingston.

He chose a quiet spot for his home, because he gave up most of his time to the study of animals.

2. His house was almost like a museum, for its walls were nearly covered with cases containing birds, reptiles, and other animals which he had stuffed, and the skeletons of creatures whose bones he had fixed in proper order.

3. Here and there were cabinets, from which he opened neat little drawers, displaying collections of gay butterflies, beetles, and other insects, and numbers of shells, surprising in their lovely tints and shapes.

4. He was never happier than when at work among his specimens, and to tell his friends some of the wonderful things he had learnt about animals was always a delight to him.

No wonder then that William and Arthur Grant,

whose home was near, liked to be invited to Mr. Johnson's house.

5. The boys took so much notice of what they saw, and seemed so eager to hear about the animals, that Mr. Johnson made up his mind to set apart a few afternoons for talks with them. They were in high glee when their friend told them what he would do, and at the same time asked them to go for a walk with him along the shore that afternoon.

6. So, with Mr. Johnson's dog Rover bounding on before them, off they started.

Mr. Johnson had so much to tell of the creatures that flitted past them, or sheltered beneath the foliage, that the boys sought eagerly for anything about which they might question him.

7. After a time, when they were sitting down to rest, Mr. Johnson said to the boys:

"The bee that just went by, and that snail crawling near us, are animals as well as faithful old Rover; but there is a great difference between them and the dog, is there not?"

8. "Yes," said William. "Rover is ever so much bigger."

"Never mind the size," said Mr. Johnson. "That does not count for much when we are arranging animals in their proper order."

"Rover has no shell, and the snail has," remarked Arthur.

9. "But the snail has no legs," said his brother.

“And neither the snail nor the dog has wings, like the bee,” added Arthur.

“Ah!” said Mr. Johnson; “there is a much greater difference. I see I must put you right. Rover has bones and the other two creatures have not. That is the chief difference that I want you to notice now.

10. “What I wish you to see is that the animal kingdom is made up of two great divisions. In one division we have animals with backbones, and in the other are all the animals without backbones.

11. “Of all the bones in the body the most important is the spine or backbone. It is not a single bone, as you might at first think from its name, but it is made up of a number of little bones, called *vertebræ*.



The Spine,
or Backbone,
in Man.



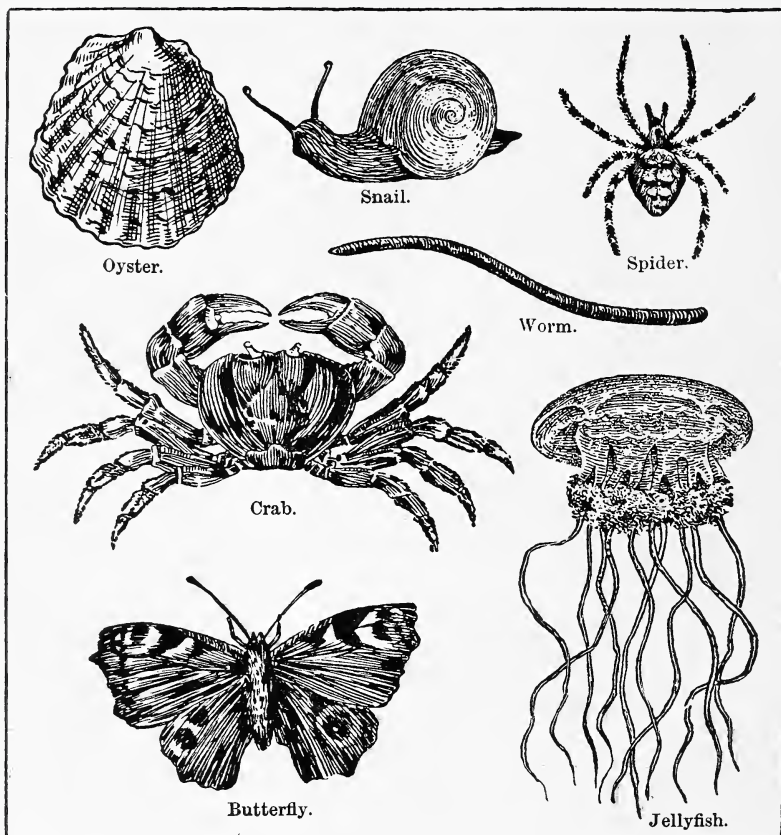
Top View of a Single Vertebra.

These are fastened into one another in such a way that the whole backbone can be curved or bent. In your own backbone there are thirty-three of them.

12. “As every animal with bones must have a backbone, and as this is made up of little *vertebræ*, we call animals with bones *Vertebrates*, and those without them *Invertebrates*.

ANIMALS WITH BACKBONES.

1. The two hard names puzzled the boys so much



Some Animals without Backbones.

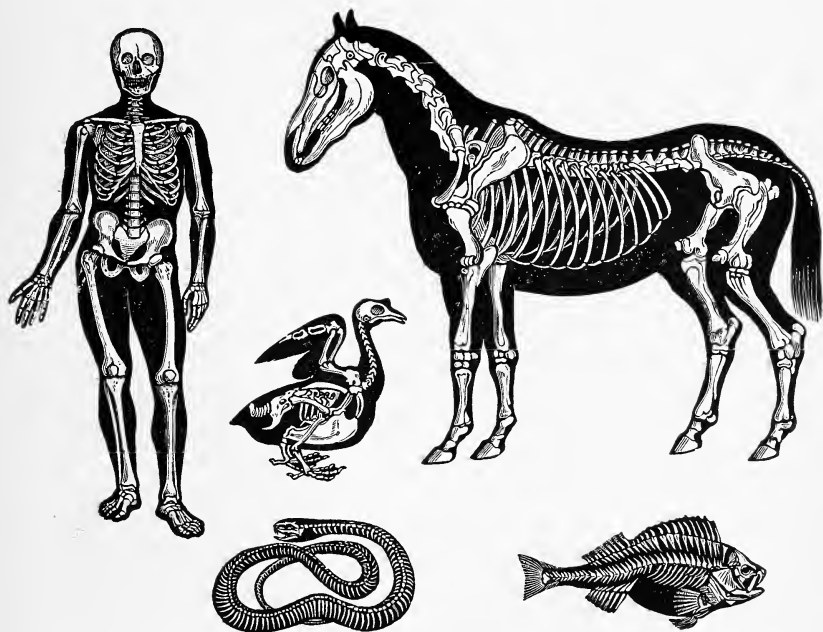
that Mr. Johnson had to wait while they learnt to say them.

“You cannot learn much about animals without meeting with a few hard words; so you may as well begin to understand them at once,” said their friend.

2. "Now which of the two divisions do you think is the more important one?"

"Oh! the animals with backbones," said William.
"At any rate, we are in their division."

3. "Very well; then we will spend most of our time in talking about the backboned creatures,"



Some Backboned Animals.

said Mr. Johnson. "They form the first and chief *sub-kingdom* in the animal world.

4. "But let me first say a few words about the animals without backbones. These are so numerous, and they differ so much in build, that we arrange them in five sub-kingdoms. Thus, we have in one the soft-bodied creatures, such as oysters and snails.

In another we place animals whose bodies are in ring-like portions: of these the crabs, lobsters, insects, and spiders have legs jointed to the body, while the worms are without legs. Then, in the other sub-kingdoms there are the sea-anemones, the 'jelly-fishes', the creatures that make the corals and sponges, and many others.

5. "Of these boneless animals I shall not say much, and we will, for the present, think no more about them. I should like to tell you a little now about the great sub-kingdom of Vertebrates, or back-boned animals."

6. "That is the sub-kingdom to which we belong," said Arthur.

"Of course," said Mr. Johnson, "and we are in the first *class* too."

7. "What do you mean?" asked Arthur.

"I mean that amongst the animals that agree in having a backbone we find such great differences in other ways, that we are able clearly to form them into classes.

8. "And into the first class, to which we of course belong, we put all animals that are fed with their mother's milk when young, and these we call Mammals.

"I think you could mention some backboned animals that are not in this class."

"Yes; the birds," said Arthur.

9. "Quite right," replied Mr. Johnson. "They

form the second class. Then we have lizards and other reptiles to form the third; while the fourth consists of frogs and other creatures, that have a fish-like life at first, and afterwards a life on land.

10. "There is one other class to complete the sub-kingdom of the backboned animals. Perhaps you can name it."

"It must be fishes," cried Arthur; "they are different from all the rest, for they can live only in the water."

11. "You are right," said Mr. Johnson. "Fishes form the fifth class."

"Now let us walk home, and, if you will come to my house to-morrow afternoon, we will have a long talk about the large class to which we and Rover belong."

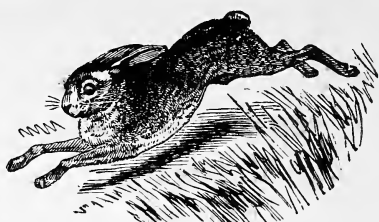
MAMMALS.

1. The next day their friend gave the boys a hearty welcome, and led them at once into a room well stocked with specimens of his "four-footed friends", as he called them. "Though that name will not do for all of them," he added; "for there you see some monkeys, which I might call 'four-handed', because they are able to use their feet like hands for grasping things."

2. "I promised that we would talk only of mam-



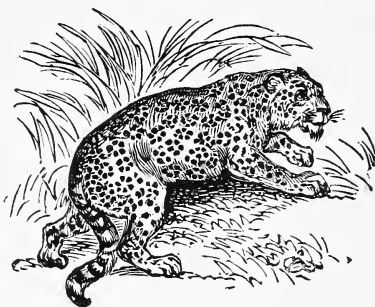
Monkey.



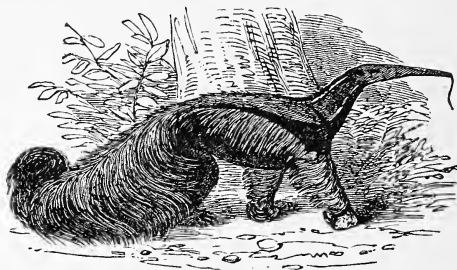
Hare.



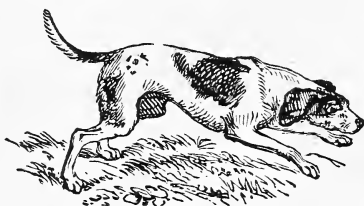
Bat.



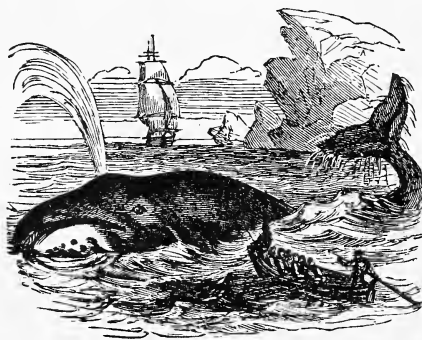
Jaguar.



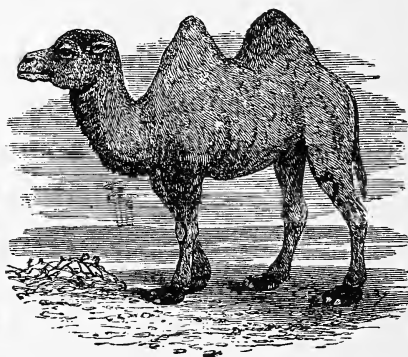
Ant-bear.



Dog.



Whale.



Camel.

Some Characteristic Mammals.

mals to-day. I wonder whether we can find in what ways they are like each other?"

"You told us that they are all fed on milk by their mothers when they are young," said William. "That is why they are all put in the same class."

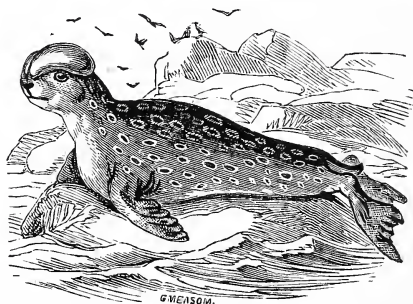
3. "I am glad you remember. But we may find other likenesses. What covering on the skin have the dog, the cow, the monkey, and the horse?"

"They all have hair," was the reply.

"And what have you?"

"Hair too," said Arthur.

4. "Very well," continued Mr. Johnson; "and that is the covering of every mammal. It forms the soft fur of the cat, the thick wool of the sheep, and the stiff bristles of the pig. It grows even on the seals and whales."



Seal—showing the Feet or Flippers.

"Are seals and whales mammals?" asked William in surprise. "I thought that all mammals lived on land, and walked."

5. "Most of them do," said Mr. Johnson. "But the seals and whales are somewhat fish-like in form, and are fitted in other ways for a life in water. For this purpose their limbs are short and in the form of flippers, of which the whale has but one pair.

6. "Again, there are some mammals—the bats—whose limbs fit them for flight in the air.

"Thus we see that the particular form of an animal is exactly suited to the kind of life it leads."

7. Mr. Johnson then led the boys close to the skeletons of a monkey, a dog, and a rat.

"We can clearly see that the bones correspond in these three skeletons," he said. "There are the backbone and the ribs in each; and you may notice that the limbs of all three animals are built on the same plan.

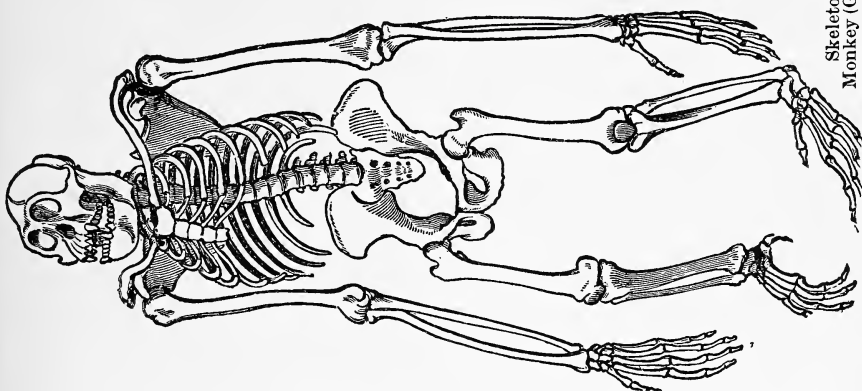
8. "The ribs form a kind of box to hold the heart and lungs, which are thus well protected. Every time we breathe we take air into our lungs, where tiny blood-vessels are spread out in a way that allows the oxygen of the air to get into our blood."

9. "Do all the backboned animals have lungs?" asked one of the boys.

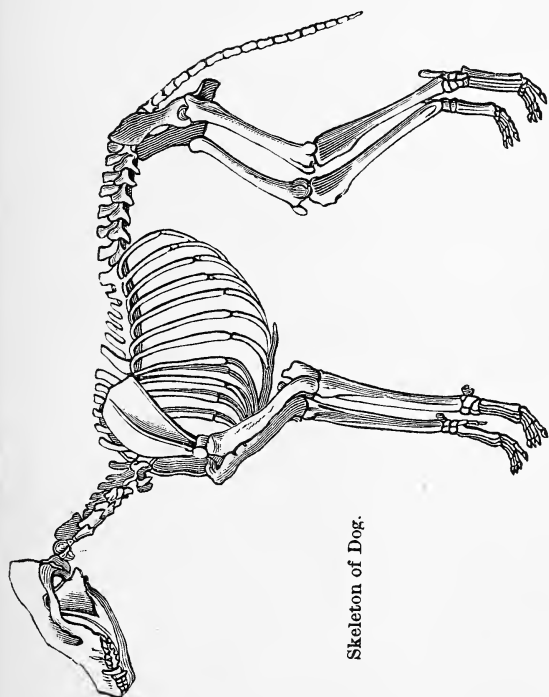
"No, the fishes have not," replied their friend. "Mammals agree with each other in having lungs and in being air-breathers. They agree, too, in having the heart divided into four chambers, as you may see in this picture."

10. "There are two chambers at the top and two below in the picture," said William. "Is every animal's heart like that?"

"Oh, no!" replied Mr. Johnson. "That is just what I want you to understand in learning how mammals agree among themselves, while differing



Skeleton of
Monkey (Gorilla).



Skeleton of Dog.

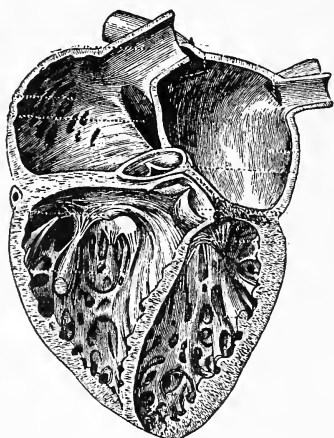


Skeleton of
Brown Rat.

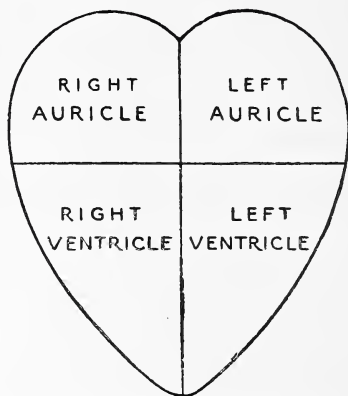
Skeletons of Mammals.

from other creatures. Birds have a heart with four chambers, but the rest of the backboned animals have not, as you will learn very soon."

11. "It is easy to understand about the milk food, the hair, and the limbs," said William, "because



The Human Heart (Mammal), opened to show the four chambers.



Diagrammatic Form of Heart.

we can use our eyes and see for ourselves, but the lungs and heart are, of course, hidden."

12. "Perhaps by feeling you can find out what I want you to learn about the blood," said Mr. Johnson. "Place your hands on this lizard; now on this frog. Next press your hand on Rover, and lastly on your own body. Do you notice any difference?"

13. The boys said that Rover's body and their own felt quite warm, and that the lizard and frog did not.

"That is because you and Rover, who belong to

the Mammal class, have warm blood. In that respect all mammals are alike.

14. "Now we must put off the rest of our talk about our own class until to-morrow, for there is still much to be told."

MORE ABOUT MAMMALS.

1. The next day Mr. Johnson began his talk to the boys by saying:

"When I tell you that at least three thousand kinds of mammals are known, I think you will imagine that there are wide differences among them. Indeed, I need but name a few—as the elephant, bat, whale, mouse, lion, monkey—and we are reminded of such different shapes and habits that you may be surprised to find the animals all in the same class. Yet they certainly are, for they agree in the points I have already described."

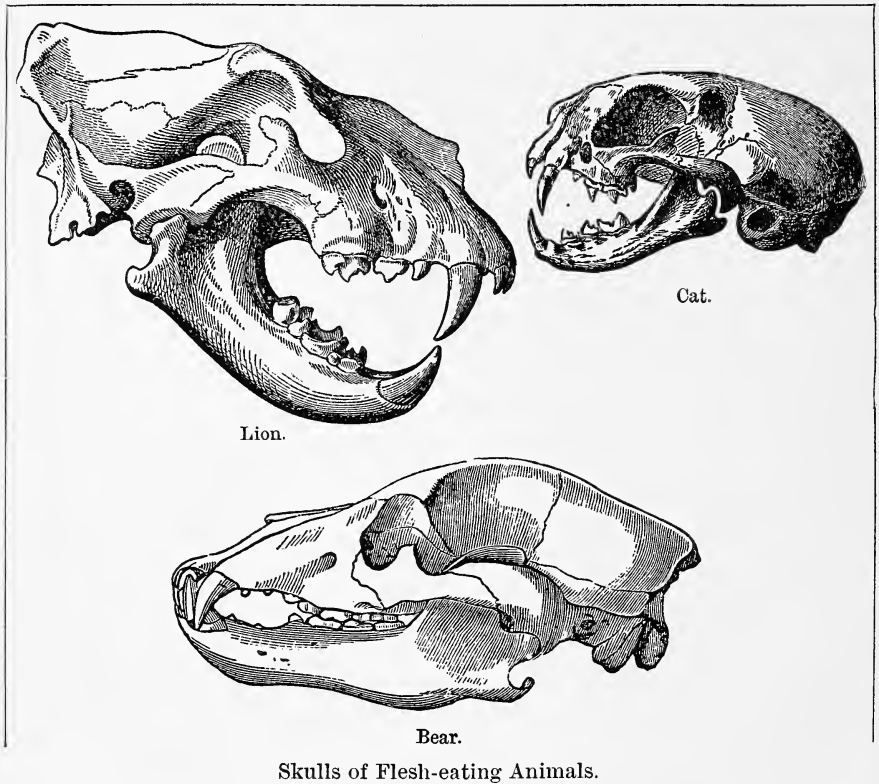
2. "Are you going to tell us about the different kinds?" asked William.

"Yes; I will show you how we arrange the large class of three thousand into groups, which we call *orders*. In doing this the feet and the teeth are our chief guides.

3. "First amongst the orders of Mammals we will place Man, the two-handed creature, and the only one which walks erect.

“Next we have the apes and monkeys, or the four-handed creatures.

4. “Here is a book in which you may see pictures of the skulls of the cat, lion, and bear. All those animals are beasts of prey, and are well furnished

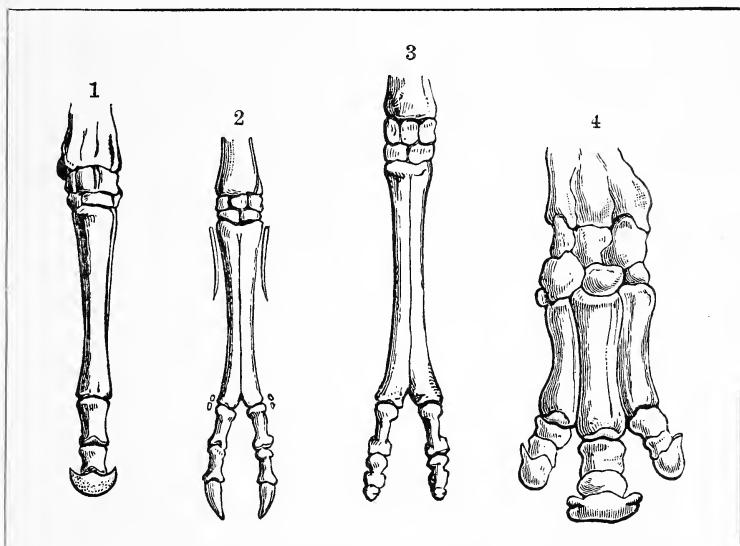


with teeth for cutting and tearing flesh, and with clawed toes. The flesh-eaters form a very large order. Some of them are the companions of man, as the dog and cat; others, such as lions and tigers, are amongst the fiercest of wild beasts. Now can you think of any mammal that is not in this order?”

5. "Yes, the cow never eats flesh," said William.

"Nor do horses and mules," added Arthur.

"Very well," said Mr. Johnson; "those all belong to the order of hoofed animals, of which there are many different kinds. Some of them have an odd number of toes on each foot, the horse having one



1, Skeleton of Hoof of Horse; 2, do. of Sheep; 3, do. of Camel;
4, do. of Rhinoceros.

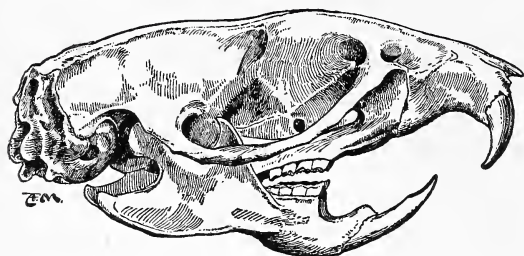
and the rhinoceros three. Others have an even number.

6. "There are the cow, sheep, deer, and pig with four toes on each foot, two of which are used in walking, while the other two do not reach the ground. And there is the camel, with only two toes."

Presently Mr. Johnson said: "Here I have the skull of a rat. See how different the front teeth are from those of the flesh-eaters."

7. "Yes, they are like long curved chisels," said Arthur.

"Those teeth are meant for gnawing," said Mr. Johnson, "and all creatures that have the same kind of teeth—

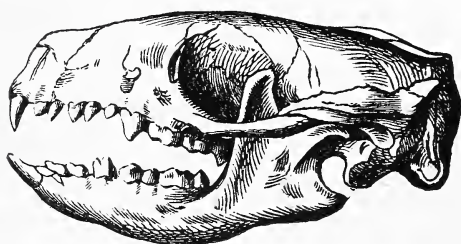


Skull of Gnawing Animal (Rat). Natural size.

such as mice, rabbits, beavers—form a separate order. Most of them are small animals, but, as you know, very destructive.

8. "Lest I should tire you, I will only briefly mention some of the other orders.

"There are the insect-eaters, with pointed teeth for crushing their favourite food; and there are the bats, known as the hand-winged order, because a web is stretched between their long fingers for use in flying.



Skull of Insect-eating Animal (Hedgehog).

9. "Finally, there are the whales, porpoises, and manatees, which, fish-like in form and furnished with flippers, disport themselves in the sea."

BIRDS.—I.

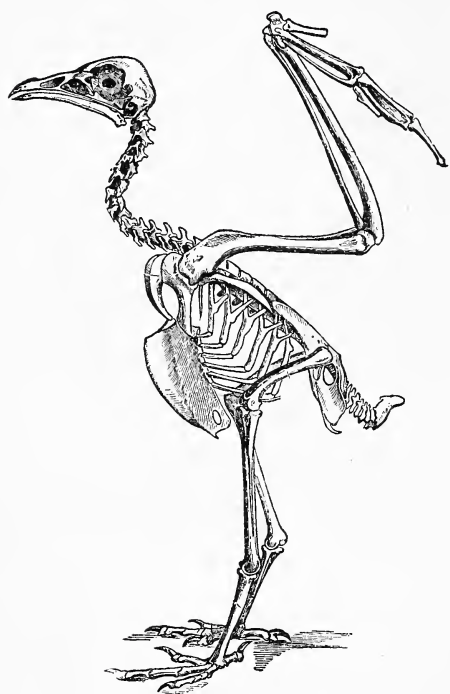
1. On the day next appointed, William and Arthur went to Mr. Johnson's house, and found that gentleman quite ready to receive them.

2. Leading the boys to a room in which he had a number of stuffed birds, he said: "I call these my feathered friends. Birds, you know, are the only creatures that have feathers for a covering, though that is not the only guide we have in placing them in their class. We distinguish them from other animals by their general shape, which so well fits them for flight through the air, by their horny beaks, and by their wings. There are other points, not so easily noticed, in which birds agree, as I shall presently explain.

3. "Unless you trace very carefully the bones in a bird's leg, you may make the mistake of thinking that the foot is that part which rests on the ground, or grasps the branches of trees. The fact is, a bird walks entirely on its toes, and the bones belonging to the foot extend up to the first joint, which is about half way between the ground and the bird's body. Above that joint you may trace the two portions of the leg. You will find that the thigh is very short, so that the knee is high up near the body and mostly hidden in the feathers.

4. "Like Mammals, Birds have a four-chambered heart, red warm blood, and lungs for breathing.

But, unlike Mammals, most birds have a number of bags or 'air-sacs' in different parts of the body, which are open to the tubes that carry air to the lungs. Moreover, some of their bones are hollow, forming air-chambers which connect with the air-



Skeleton of a Bird of Prey (Vulture).

sacs. These air-sacs and hollow bones not only help to render the body light, thus fitting it for flight in the air, but they also aid the lungs in the work of keeping the blood pure.

5. "Here is the skeleton of a bird. Notice how firm and compact are the bones of the body. On the other hand the neck has many joints, so that the bird, when alive, could bend it in various ways.

The neck is always long enough to allow a bird to plume every part of its body, and to reach the gland which gives out oil for dressing the feathers.

6. "A bird's fore-limbs are not for grasping or picking up food, but generally for flying, and its mouth is supplied with a stiff, horny bill or beak.

7. "In some birds the bill is so shaped that food

can be held or torn with it, as with the hooked bill of the vulture; in others it assists in climbing, as in the parrots. Some bills are pointed, so that small seeds and insects may be picked up by them; others, being flat, like the duck's bill, serve as both a shovel and a strainer; others, again, as in the waders, are very long.

8. "As a bird has no teeth, it needs some other means of grinding hard food. The gizzard serves this purpose. It is a kind of bag, or stomach, with a very tough lining. Into it the grain-eating birds swallow small stones, and these help to grind the food as it is rolled about by the movements of the hard walls of the gizzard."

BIRDS.—II.

1. "It is chiefly by comparing their bills and toes that we are able to group birds into orders," said Mr. Johnson.

"The first order includes all the *Birds of Prey*. The vulture and the buzzard, which you see here, will serve as examples."

2. The boys saw how well fitted for seizing and tearing flesh were the hooked beaks and sharp talons of these birds.

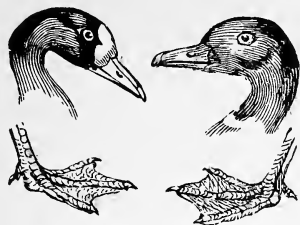
3. "The *Perchers* form the largest and most numerous order of birds," continued Mr. Johnson.

They, like the birds of prey, have three toes in front and one behind. Amongst them we have the warblers; the solitaire, whose solemn music reminds us of the notes of a psalm-tune; the jays, the jabbering crows, and the pretty banana-bird, with its famous whistling powers and its liking for ripe bananas, oranges, or sour-sops; the golden-breasted cashew-bird, the quits, and the finches."

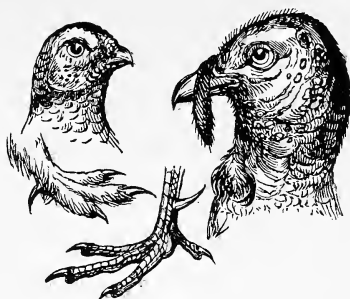
4. Pointing to a case of lovely humming-birds, Mr. Johnson added: "In the same order we place those 'gems of the feathered race' which hover over the flowers, or flit from twig to twig in search of threads or spiders'-webs for their dainty little nests. These different kinds of birds, which I have named because you see them here, give some idea of the great variety in the orders of Perchers.

5. "Now look at this case of parrots and parroquets. They represent to me a third order—the *Climbing Birds*—which, with two toes turned forward and two behind, are well able to creep along the stems of trees in search of insect food. In the same order we place the may-bird, the woodpecker, and the familiar savannah-bird."

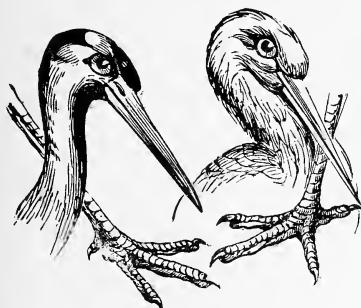
6. The children's attention was next drawn to a guinea-fowl. "This bird may serve us as an example of the *Scratching Birds*, to which order the quail and the common fowl also belong," said Mr. Johnson. "These mostly have strong, short legs, with three toes in front and a short one



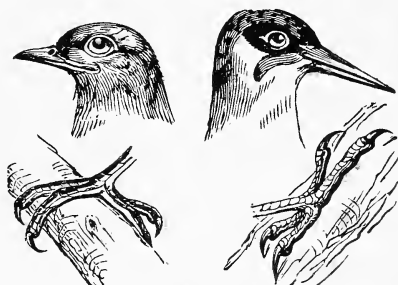
Heads and Feet of Swimmers.



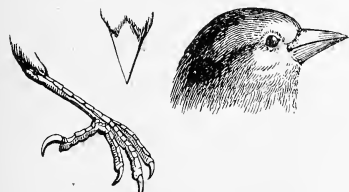
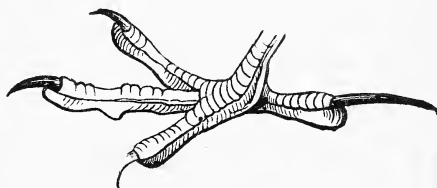
Heads and Feet of Scratchers.



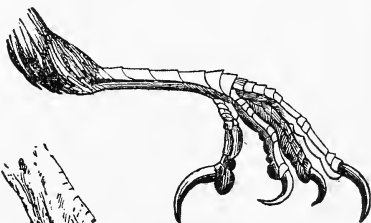
Heads and Feet of Waders.



Heads and Feet of Climbers.



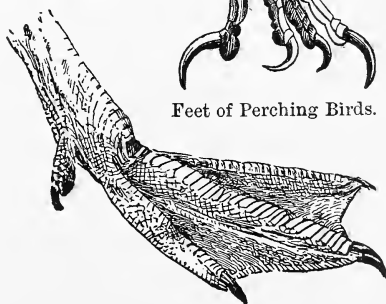
Heads and Feet of Perchers.



Feet of Perching Birds.



Head and Foot of Bird of Prey.



Foot of Swimming Bird.

behind. With limbs thus built, they are well able to scrape up the soil in search of food.

7. "I have already shown you an egg laid by the largest of living birds, the ostrich, an inhabitant of Africa. This bird belongs to the small order of *Runners*, which are unable to fly.

"Thus far I have shown you only birds that live on land. In the next case you see some that are fitted for a life on or near the water.

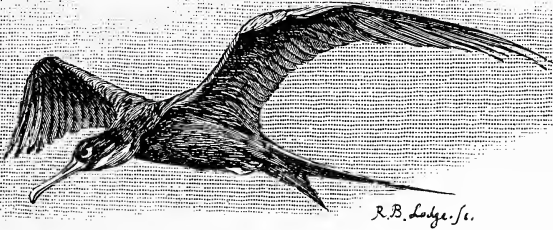
8. "And first we will look at the *Waders*, which are sometimes called the 'stilted birds', on account of their long, thin legs. These enable them to wade in the grassy swamps and in shallow water in search of small fishes, insects, worms, molluscs, and other food. Here you see the heron and the bittern—both very fine birds,—the snipe, and the little sandpiper.

9. "The seventh order of birds consists of the *Swimmers*. Of these the ducks and geese are well known to you. Here is a pelican," added Mr. Johnson, pointing to a large and awkward-looking bird, whose enormous bill and pouch gave it a curious appearance. "The pouch serves as a net into which the bird scoops the fish it takes.

10. "And here is the frigate-bird—remarkable for the length of its wings. Although the bird is not very large, its wings spread wider than a man's outstretched arms. It is a swift flyer and a good fisher; but I am afraid that if this booby in the

next case could speak, it might tell how the bold frigate-bird used to rob it of its food by making it disgorge the fish it had taken.

11. "The feet of the swimmers, as you have most likely noticed, are webbed, either partly or wholly;



Frigate-bird.

the webbing forming a paddle by which the bird drives itself through the water."

REPTILES.

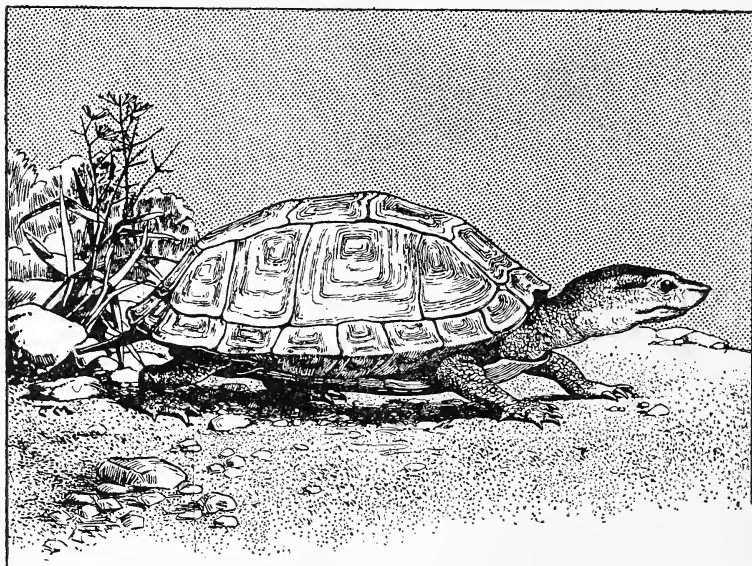
1. In order to be ready for the boys' next visit, Mr. Johnson took from a box several skins of snakes and lizards and laid them on the table, together with some hollow, horny cases which had once been the homes of tortoises and small turtles.

Before he had quite finished his preparations the boys arrived.

2. "Come this way!" Mr. Johnson called to them, in his cheery way. "We shall talk about the third class of backboned creatures to-day, and I am getting some of them ready for you to see."

“They are not as pretty as the birds,” said Arthur. “Will and I have been talking about your lovely specimens many times since our last visit.”

3. “So you have not forgotten what I said about the structure of the birds, and how well it fits them for the life they lead,” said Mr. Johnson.



Tortoise.

“Oh, no!” replied the boys.

“Then look carefully at these reptiles, and tell me in what way they differ from the birds.”

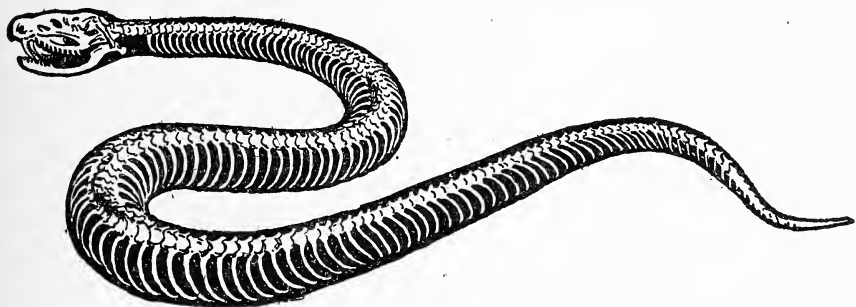
4. “That is easily seen,” said William. “They have neither feathers nor wings.”

“They have a tough skin with scales on it,” added Arthur.

5. “Quite right,” said Mr. Johnson. “And the tortoises and turtles are protected by strong horny

plates, which fit together so as to form a kind of box in which the creature lives. The scales and plates must be a good protection when the reptiles move amongst the stones or fallen trees.

6. "Here is the backbone of a snake," added Mr. Johnson. "See how numerous are the bones in it, and how beautifully they fit so as to allow them to turn upon each other. I think, after seeing this,



Skeleton of a Snake.

you can understand how it is that the snake bends its body so easily."

Mr. Johnson explained to the boys how the scales on the under part move with the ribs, and enable the snake to glide forward.

7. "Like the animals in the first two classes, reptiles have *lungs*; but I must tell you of an important difference between the heart of a reptile and that of a mammal or a bird. A reptile's heart has only *three* chambers—two upper and one lower. In consequence, the circulation of its blood is not so perfect as that of the creatures in the two higher classes, nor is the blood so warm.

8. "Look at this turtle's limbs," he added, as he picked up a small turtle from the table. "The toes are inclosed in a hard covering, so that the feet are formed into flippers, and serve as excellent swimming-paddles. They remind us of the flippers of the seal. When alive this little reptile was a capital swimmer, though it was almost helpless on the land. You see that its fore-limbs are much longer than the hind pair, and that its *carapace*, as the upper part of its case is called, is much flattened.

9. "The green turtle is made use of as food, an excellent soup being made from it, and its eggs are also good to eat.

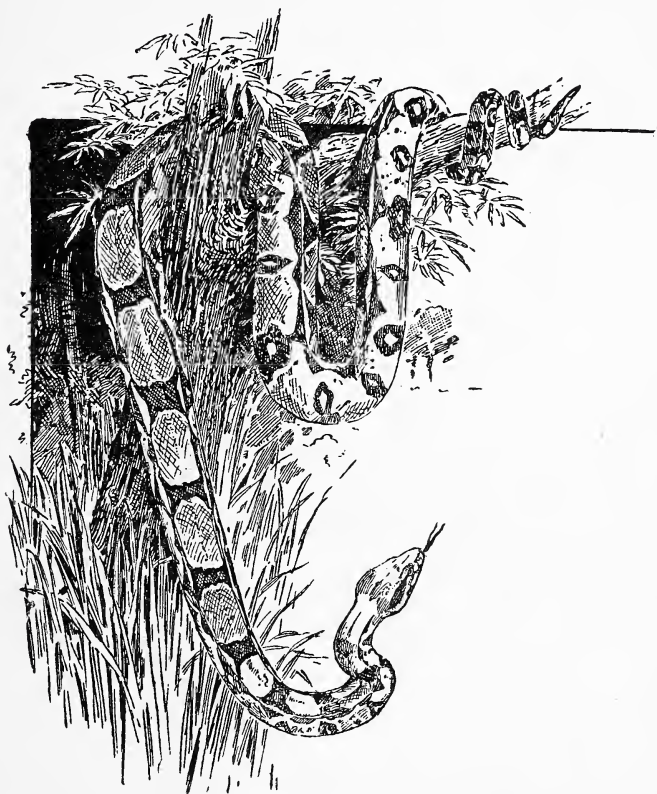
"The horny plates of the hawk's-bill turtle furnish us with the 'tortoise-shell', so largely used for making pretty articles."

"I think that the lizards are the prettiest of all the reptiles," said Arthur.

10. "Some of them are indeed graceful creatures," said Mr. Johnson, "and Jamaica seems to be a favourite place with them, judging by their vast numbers. Here is an iguana," he added, at the same time holding up a lizard with a ridge of pointed scales on its back and long tail, and a large fold of skin under its throat. The Iguana family is a very large one, and although these lizards are not of very pleasing appearance, to some people their flesh is an agreeable food.

11. "It may surprise you to learn that some reptiles—namely, the tortoises and turtles—have no teeth, but a horny beak instead, with which they seize their food.

"In the snakes, lizards, crocodiles, and alligators



Boa-constrictor.

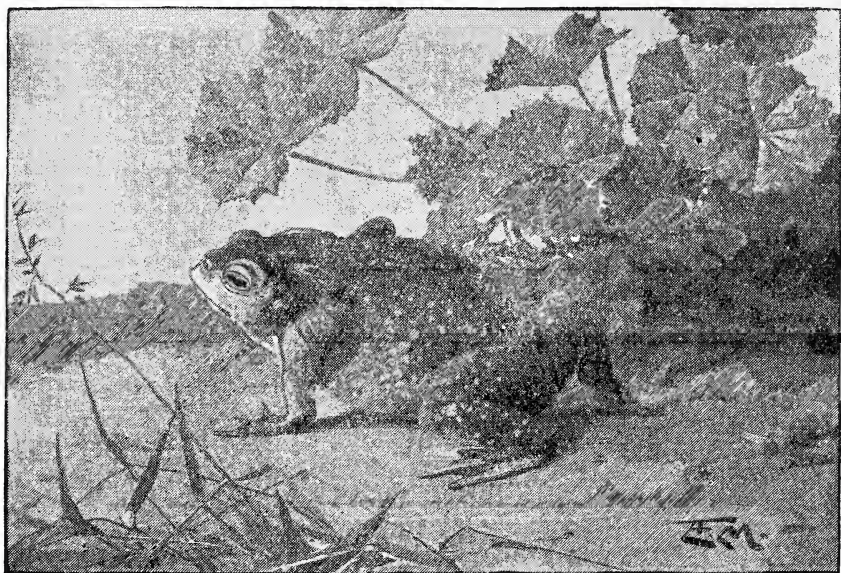
the teeth are numerous and pointed. In the snakes they are turned backwards, like little hooks, and are well shaped for holding the prey while it is being swallowed.

12. "As you may see from my specimens, there

are many kinds of snakes, and their sizes vary very much. With some of them the bite is poisonous. The huge boa-constrictor, which coils itself round its victims, the deadly rattlesnake, and the fierce crocodiles and alligators are very dangerous to man."

AMPHIBIANS.

1. "You have not said anything about the frog," said William. "Is it not a reptile?"



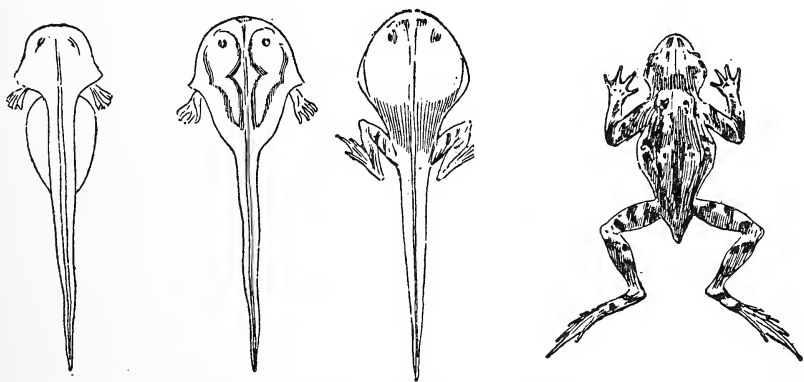
The Toad.

"No," replied Mr. Johnson, "it belongs to the next class of backboned animals, and differs in a striking manner from any reptile, as I will presently explain. The animals of the frog class agree with

the reptiles, however, in having cold blood and a three-chambered heart. Their skin is mostly soft, cool, and moist.

2. "We put toads and salamanders in the same class with frogs, and call them all *Amphibians*, because they live both in water and on land.

"At first they have gills, and can only breathe the air that is in water, as fishes do. In time



Different Stages in the Development of Tadpoles into Frogs.

lungs grow, and then the gills generally disappear, and the animal mostly gives up its life in the water for a life on land.

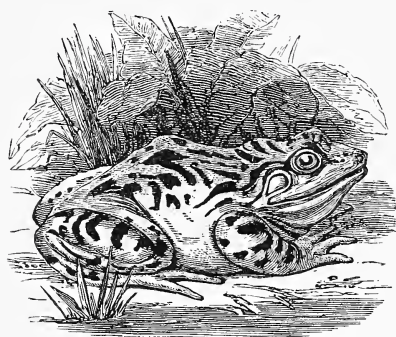
3. "So, as I told you, they differ in a very striking way from reptiles, for those creatures never have gills, but always breathe by means of lungs."

"Yet turtles and crocodiles, which are reptiles, live in the water," said William.

"True," said Mr. Johnson, "but in breathing they are obliged to put their nostrils above the surface to obtain air."

"I cannot understand how any creature can find air in the water," said Arthur.

4. "Well, let me explain," said Mr. Johnson. "You know that water will dissolve sugar and salt, so that, although they are in it, they cannot be seen. So, too, water can dissolve the oxygen gas which animals need to keep their blood pure.



Bull-frog.

5. "Oxygen can get into the blood either in the gills or in the lungs; but the gills are made for taking it only from the water, and the lungs for taking it from the air. That is why not only fishes, but also amphibians in their first stage of life, having gills, can live entirely under water, and why animals with lungs cannot."

6. The boys listened to Mr. Johnson's explanation, and seemed to understand it. Then they asked their friend if he had any other amphibians to show them.

7. "Here is a large bull-frog," he continued. "When alive it was not satisfied with snails and insects, but would eat a small bird if it had the chance. And here is a pretty little tree-frog, with very peculiar feet. They are fitted with suckers, by which the little creature holds on to the tree.

"Of course you observe that the fully-developed frogs and toads are without tails; the salamanders,

however, are provided with tails. We therefore readily group the amphibians into two distinct orders.

8. "One thing I had almost forgotten to tell you. The skin of the amphibians is full of little holes, through which water finds its way in. Owing to this, in a manner I cannot now explain, the creatures of this class are able to stay for a long time under water before coming to the surface to fill their lungs with air."

FISHES.—I.

1. The next time Arthur and William went to see Mr. Johnson, the afternoon was spent in a long talk about fishes.

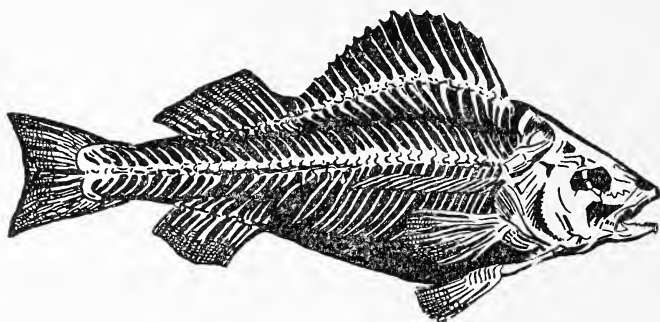
"I have not many specimens to show you to-day," said their friend; "though enough, I think, to make clear to you that fishes are very different in build and habits from the animals of other classes.

2. "Here I have a very pretty skeleton of a bony fish, in which you may plainly see the long backbone with its many joints. Every bone or vertebra of the backbone is hollowed out on each side, where it meets the next bone; and the rim of one hollow makes a joint with the rim of the next. In this way the backbone bends easily, and enables the fish to turn and twist in the water."

3. "Why do you say this is the skeleton of a *bony* fish? Have not all fishes bones?" asked Arthur.

"Not true bones," replied Mr. Johnson. "A few kinds of fishes, such as the shark and the skate, have only gristle.

4. "Let us now see how fishes differ from the rest of the backboned animals. You know what happens to a fish if you take it out of the water!"



Skeleton of a Bony Fish.

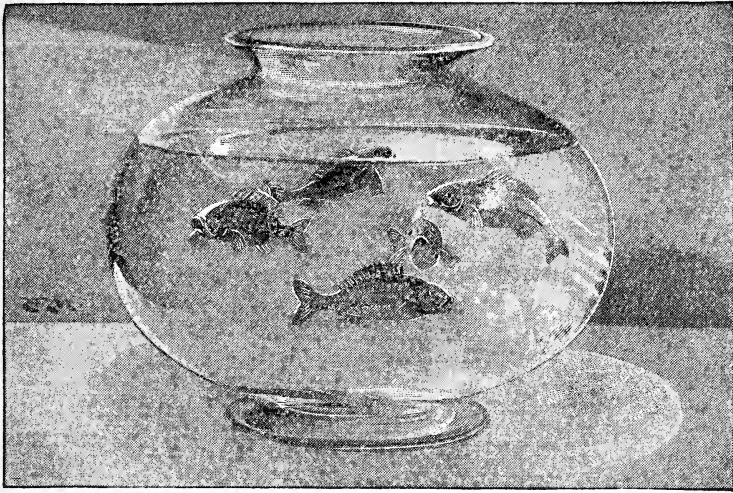
"It very soon dies, of course," said William.

"Yes; it becomes suffocated just as surely as we should be if we were made to remain under water."

5. "That is because it has gills for breathing, and we have lungs," said Arthur.

"Of course! When we talked about the amphibians I told you how it was that gill-breathing animals could obtain air from the water. Watch the gold-fish in this bowl, and you will see how they breathe."

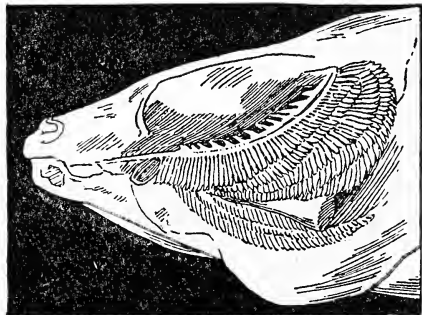
6. "They keep on opening and shutting their mouths," said Arthur.



Bowl of Gold-fish.

"Just as if they were gulping the water in," added his brother.

7. "That is just what they are doing," said Mr. Johnson. "But you must not think they are drinking it. They send it out again through the gill-slits, which you may see regularly opening for that purpose."



Gill of Fish.

8. "Here is a dead fish that has been brought to me from the market. Let us examine its gills. First, I lift up the gill cover, which fits over the

gill-slit. Under it you plainly see the thin flat gills lying closely over each other. Notice how beautifully fringed they are."

9. "And red too!" exclaimed William.

"Yes. They are red because they are full of little blood-vessels, which are placed just where they can be well-bathed by the water on its way out. Then some of the air in it can pass into the blood within the tiny vessels and purify it.

10. "Now look at the covering over the fish. It is the very best kind it could have for passing easily through the water."

"Fishes have scales for a covering," said William.

"Yes. Pass your hand from the head to the tail of this fish." The boys did so, and the fish felt quite smooth.

11. "Now pass it along the opposite way," said Mr. Johnson. In doing so the boys could plainly feel the small scales, and some of them came off on their hands. They were nearly round, and were thin and hard.

12. "The scales are fixed only in front," said Mr. Johnson, "and each one laps over the one behind it, in something like the way a bird's feathers overlap each other. They are of different shapes in different kinds of fishes, and are often marked with fine lines, which cause them to glow with beautiful colours."

13. "One day Arthur and I went fishing," said

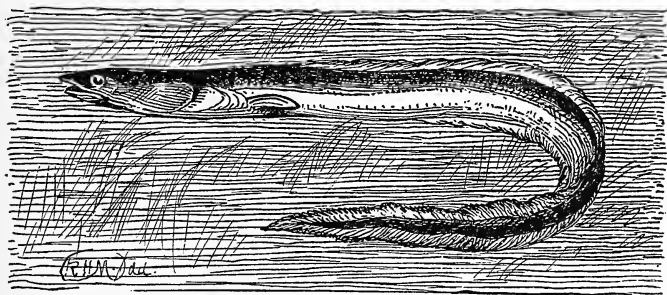
William, "and it was not easy to pick up the fishes we caught, because they slipped out of our hands. Why are they so slippery?"

"They are able to send out a kind of slime over their scales," said Mr. Johnson, "and, as you may suppose, this helps them to pass easily through the water."

FISHES.—II.

1. "If you watch the gold-fishes in the globe you will be able to find out how they drive themselves along," said Mr. Johnson.

2. "Notice the two pairs of small fins at the sides. Along the middle of the back, as well as under the



The Eel.

body, you see other fins, which help to balance the fish and keep it upright. For small movements the fish uses its paired fins, but to drive itself swiftly forward it sweeps its large tail-fin from side to side. The fins do not have the same shape in

all kinds of fishes, and some fins are soft, while others are stiff and prickly."

3. "How beautifully they glide along," said William, as he and his brother watched the pretty fishes turning from side to side, or darting now and then through the water.

"Their boat-like form seems the very best for passing through the water," said Mr. Johnson. "But fishes differ in shape very much according to the life they lead."

4. "Yes," said Arthur, "the eel is long and round."

"And the sole is a flat fish," added William.

"Quite true," said Mr. Johnson. "The eel makes its way through the mud in the rivers and lagoons, and the sole searches for food along the bottom of the sea.

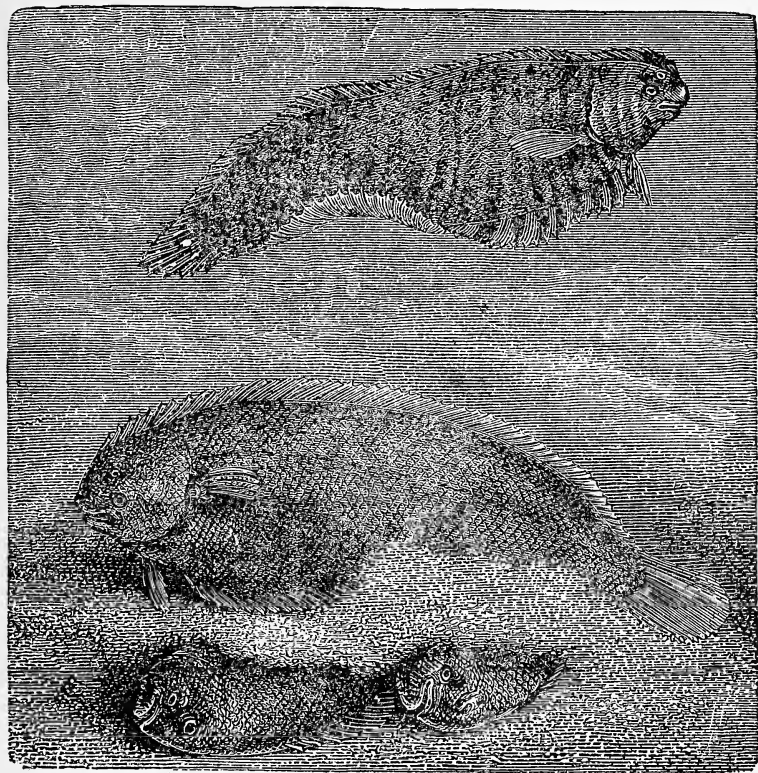
5. "For this kind of life its flat shape is very suitable, as it can lie close to the bottom, with one side uppermost, and, as you know, it has both eyes on this side. The upper side has a colour resembling the bottom of the sea, so that the fish is not easily seen by its enemies."

6. "What do you mean by its enemies?" inquired Arthur.

"I mean the other fishes that would prey upon it. You must understand that many fishes are flesh-eaters, and feed upon each other. Fish also eat insects, worms, or the eggs of other fishes."

7. "I did not know that fishes laid eggs," said William.

"Did you not? Why, a single fish lays thousands, aye, millions of them. They are very tiny, and



Soles.

form the roe, which no doubt you have seen in a fish at table.

8. "At the time for spawning, many kinds of fish come near the shores to lay their eggs. And it is well that a fish casts out such an immense number of them, because they are greedily eaten, not only

by fishes, but by other water animals, and so are the fry, as the newly-born fishes are called.

9. "There is an important difference between fishes and the other backboned animals that I must not forget to mention," added Mr. Johnson. "You remember that the hearts of mammals and birds have four chambers, while those of reptiles have three. Now a fish has a two-chambered heart, and in this way is distinct from all other backboned animals excepting the amphibians in their first stage of life."

INSECTS.—I.

1. At their next visit to their friend, the naturalist, the boys found the tables filled with trays of lovely insects. It was indeed a grand display, and they were lost in wonder at the beautiful sight.

2. "We now leave the animals with backbones," said Mr. Johnson, "and we come to those that have no bones—the Invertebrates, as they are called. Of these there are no less than five sub-kingdoms. As I am not able to speak of all these sub-kingdoms, I have chosen a single class in one of them.

3. "In the cases and drawers which I have put out you see scores of different kinds of insects, some of them of wondrous beauty. With all their differences of colour and shape, their bodies are all

formed on the same plan, and that is why we place them in one class.

4. "Now look at some of the specimens. If you take notice you will see that every insect is made up of three distinct parts—head, chest, and abdomen.

"The divisions between these parts are so plain that it appears as if the insect were cut almost through in two places. That is why it is called 'insect', for the word means 'cut into'."

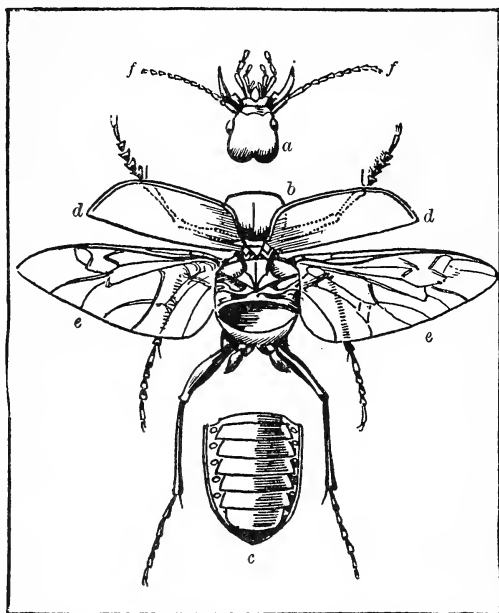


Diagram showing the parts of Insects.

a, Head; *b*, chest; *c*, abdomen; *d d*, wing-cases;
e e, wings; *f f*, feelers.

5. "I see the three parts quite clearly," said Arthur, "and I notice that the legs and wings are always on the middle part."

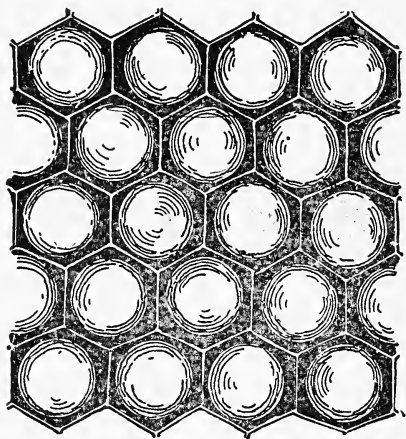
"Yes," added William; "but do you observe the number of legs. Each insect has six. I have counted them on ever so many, and the number is always the same."

6. "Quite right, William," said Mr. Johnson. "Now if you look very closely you may find that the middle and hinder parts of an insect are made

up of ring-like portions; these are covered by a tough or horny skin, and they overlap each other in such a way that the body is not stiff, but is able to move freely."

7. "The wings as well as the legs are fixed to the chest," said Arthur. "Have all insects wings?"

"No, but most have," said Mr. Johnson. "Generally there are two pairs of wings, or else one pair of wings overlapped by a pair of wing-cases, as in the beetles. Now notice the insect's head. It is not in rings like the rest of the body. At the sides the eyes are placed; and very wonderful eyes they are. They are not single, like our own, but each is



Portion of a Fly's Eye (magnified).

really a mass of little eyes, numbering many thousands in some insects."

8. "What are those thin things that grow out like long horns from some of the insects' heads?" inquired Arthur.

"They are feelers," replied Mr. Johnson, "and that is a good name, for the insects feel their way with them.

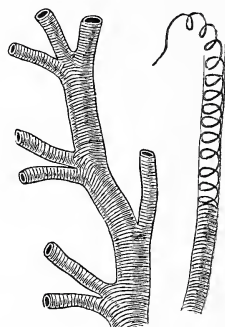
9. "While speaking of the head, we must not forget the mouth. This is not easy for you to see,

but I may tell you that it is fitted with three pairs of jaws. These differ in form to suit the kind of food the insect takes.

“Insects that feed on solid food, which they bite or chew, have short, sharp-edged jaws. Others, that feed on the blood of animals or the juice of plants, have long mouth-parts of the best shape for licking, sucking, or piercing.”

10. “You have not told us how insects breathe,” said Arthur.

“They have neither lungs nor gills to breathe with,” said Mr. Johnson. “Instead, they have tiny tubes, which open to form breathing-holes in the sides of the body, and branch inwards to carry the air to the blood.”



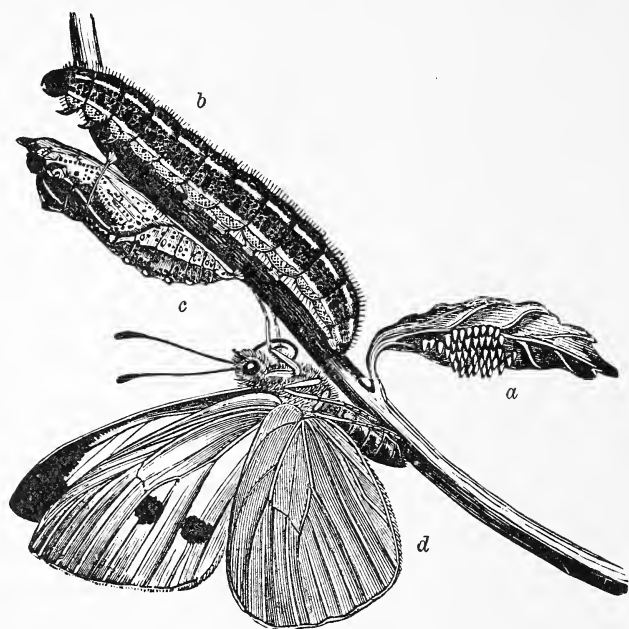
Breathing-tube
of a Fly.

INSECTS.—II.

1. “I must now say a few words about the wonderful changes that take place in the life of insects,” continued Mr. Johnson. “Many insects have three stages of life, and very few, when hatched from the eggs, resemble their parents.

2. “From the egg a grub, maggot, or caterpillar comes forth, which, after growing to its full size, leaves off eating and seems to do nothing but rest.

Often it first spins for itself a cocoon or covering, in which it passes through its second stage of life, called the chrysalis. During that stage a great change is steadily going on, and at last from the dry, dead-looking chrysalis, the perfect insect bursts forth."



Metamorphoses of Butterfly.

a, The eggs; *b*, caterpillar; *c*, chrysalis; *d*, the perfect insect.

3. The boys thought it very wonderful that one creature should have so many different shapes in its lifetime, and William said that it reminded him of the tadpole changing into a frog.

4. "No doubt insects are of some use in the world," said William, "but many of them are very troublesome sometimes, and a nuisance to us. They often destroy the wood of our trees, furniture, and

houses; they feed on our crops; and sometimes they give us proof of their stinging or biting powers."

"Do not think too much of the trouble they give us, William," said Mr. Johnson. "Rather think of the great amount of good they do.

5. "If their bodies do not serve as food for us, as so many of the larger animals do, at least the insects help to provide our food. This they do by carrying pollen to the flowers into which they creep in search of sweet juices; for without this pollen the fruits would not begin to grow. Only think what a large quantity of fruit we eat, and then consider how badly off we should be if the insects did not do their part towards causing the fruits to grow.

6. "Then you must not forget that the bee makes honey and wax, which we find useful; that the silkworm spins silk, which we weave into material for clothing; and that from the cochineal insect we get a rich red dye. Insects do good, too, by clearing away decaying matter; and, in some cases, by stirring and loosening the soil.

7. "I hope, boys, that in our talks about animals you have heard enough to lead you to like them more than you ever did. Perhaps you may look with interest on animals that hitherto you have thought ugly or horrid.

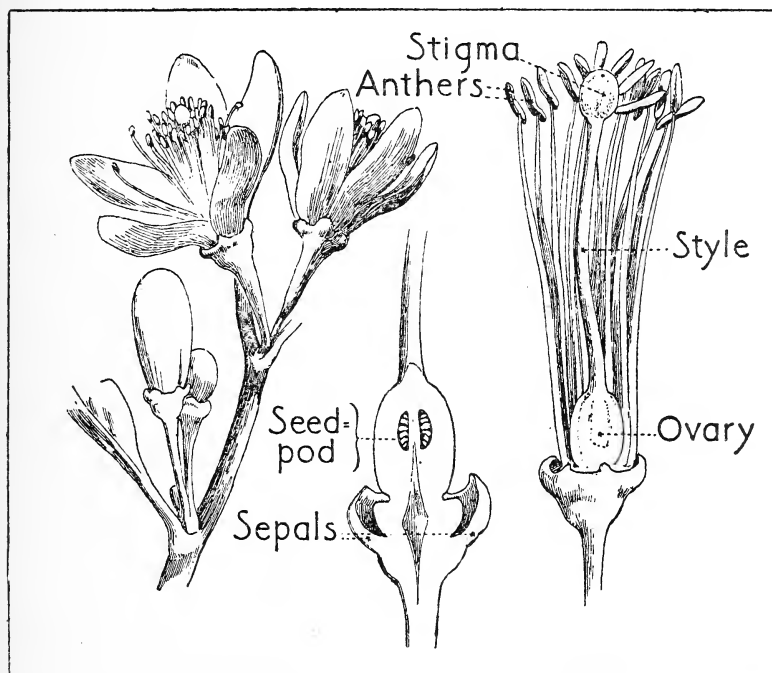
8. "One who loves and studies Nature will see as much beauty in a spider or a snake as in the more attractive creatures which are general favourites.

For he will see how wonderfully each creature is fitted in structure and in instinct for the life it leads. He will find, too, that each animal is part of a great plan of creation, and that each kind fulfils duties which no other kind could perform so well; and I think he will be inclined to say that in Nature there is a place for everything, and that everything is in its place."

PART II.—PLANT-LIFE AND SOILS.

THE PARTS OF A FLOWER.

1. I should like you to gather and examine any of the numberless flowers that grow. An orange



An Orange Flower and its Parts.

flower does well for the purpose, because its parts are easily seen.

2. In the centre you will find a small round body, with a club-shaped growth rising from it. You

may perhaps find the latter to be sticky at the top; and a magnifying-glass might show you that some yellow dust is sticking to it.

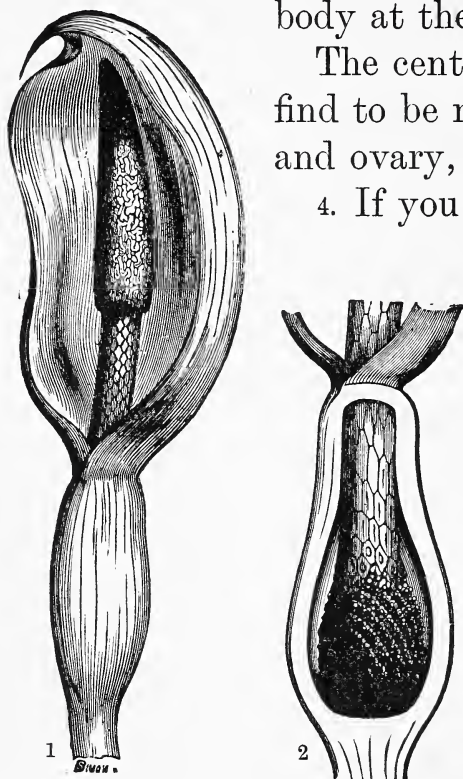
3. This sticky part is known as the *stigma*, its slender stalk is called the *style*, and the rounded body at the bottom is the *ovary*.

The central part, which you thus find to be made up of stigma, style, and ovary, is known as the *pistil*.

4. If you cut across the lower part of the pistil, your sharp eyes may discover a number of little hollows. In these lie tiny seed-buds, or plant-eggs as we may call them, which might have grown into seeds some day if you had not picked the flower.

5. It is the leaves and the roots that attend to the feeding of the plant, and it is left to

the flowers to produce seeds for the growth of new plants. And as we have found that the young seed-buds are held in the lower part of the pistil, I think we shall be right in calling that the most important part of the flower.



1, Inflorescence of Coco. 2, Lower part with portion of spathe removed.

6. Outside the pistil, and next in order, come the *stamens*: each formed of a slender stalk having a golden knob at the top called the *anther*. This is made up of two little bags which are filled with grains of *pollen*, looking like golden dust.

7. Now the little seed-buds in a pistil will not begin to grow into seeds unless some pollen comes to rest upon the stigma. When that happens the seeds very soon quicken and grow. You see, then, that the stamens which bear the pollen are also a very important part of any flower.

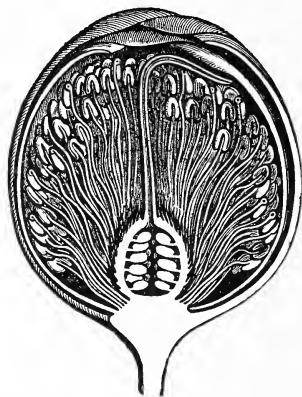
8. As for the beautiful white petals, and the green sepals, the orange flower might carry out its work and produce seeds without them.

Many kinds of flowers, indeed, of which the coco is one, have neither petals nor sepals. The flowering spike of the coco bears only stamens and pistils; and, for protection, these are surrounded by a sheath, or *spathe*, as it is called.

9. Of what use, then, are the outer parts of the orange flower?

They serve to fold around the stamens and pistil in the bud, and to protect them until the pollen is ripe, and ready to be scattered on the stigmas.

10. The bright, sweet-scented petals also serve



Bud of Annatto Flower just about to open (cut through to show Stamens, Ovary, &c., enveloped by Flower Leaves).

another purpose, as we shall soon learn. They wither and drop as soon as the anthers have cast out the pollen; for then their work is done.

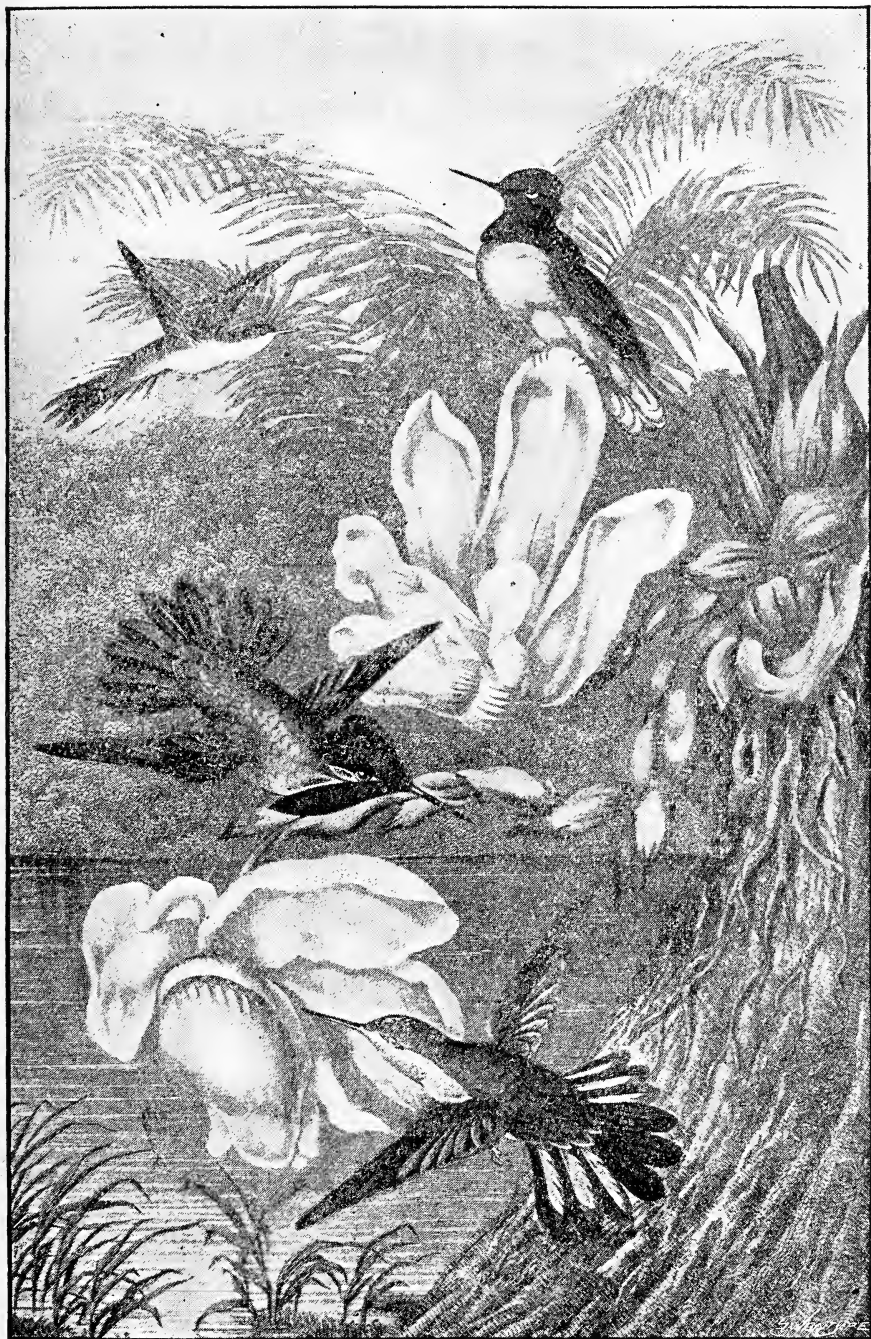
In many flowers the sepals drop off, too; but on the orange they remain, and you may see them at the bottom of the ripe fruit.

FLOWERS AND SEEDS (FERTILIZATION).—I.

1. As the anthers are so close to the stigma in most flowers, I dare say you think that it is an easy matter for their pollen to fall upon it, and thus cause the little seed-buds to start their growth into perfect seeds.

2. But this does not happen in some flowers. On the contrary, there are often contrivances to prevent the stigma receiving pollen from its own flower, for where that takes place the seeds are not likely to produce strong plants. In such cases it is better that the stigma of a flower should be dusted with pollen from another flower of the same kind.

3. In many cases, stamens and pistils do not grow in the same flower, or even on the same plant or tree. In the gourd, or melon, for instance, you may find both male flowers (having stamens) and female flowers (having a pistil) on the same plant. In a corn-plant the tassel-shaped male flower, with its load of golden dust, is very different in appear-



Humming-birds among Tropical Flowers.

ance from the rest of the blossoms, which bear the pistils. The palm and begonia give other examples of the stamens in one flower and the pistil in another.

4. Again, in the nutmeg we shall find none but female flowers on some of the trees, and only male flowers on others.

But how is the pollen to pass from one flower to another when they are so widely separated? It must either float through the air, or some little friends must be at hand to carry it! Yes, that is exactly what is done.

5. A writer thus describes what the little friends of the flowers do. He says:

“Most persons in the West Indies have noticed, at some time or other, butterflies, bees, and humming-birds flitting from flower to flower in the bright sunlight. The butterflies dart their long probosces right into the corollas: the bees creep into the flowers, and the humming-birds, apparently motionless, but really beating their wings with wonderful rapidity, remain poised in front of a flower whilst they probe it to the bottom with their long and slender beaks.

6. “The humming-birds, the bees and the butterflies, the beetles and the moths, all go to the flowers to rob the *nectar*—a juice containing sugar.

“But no matter how the several parts are arranged, they cannot get at the nectar without

coming in contact with the anthers, so that the pollen escapes and clings to them. And thus, when another flower is visited, the pollen is brushed against the sticky stigma, and so remains.”¹

FLOWERS AND SEEDS (FERTILIZATION).—II.

1. We can now understand why so many flowers display bright colours, or give out sweet odours. By so doing they attract the attention of insects and small birds, which, in feeding on their sweet juices, carry the pollen from flower to flower.

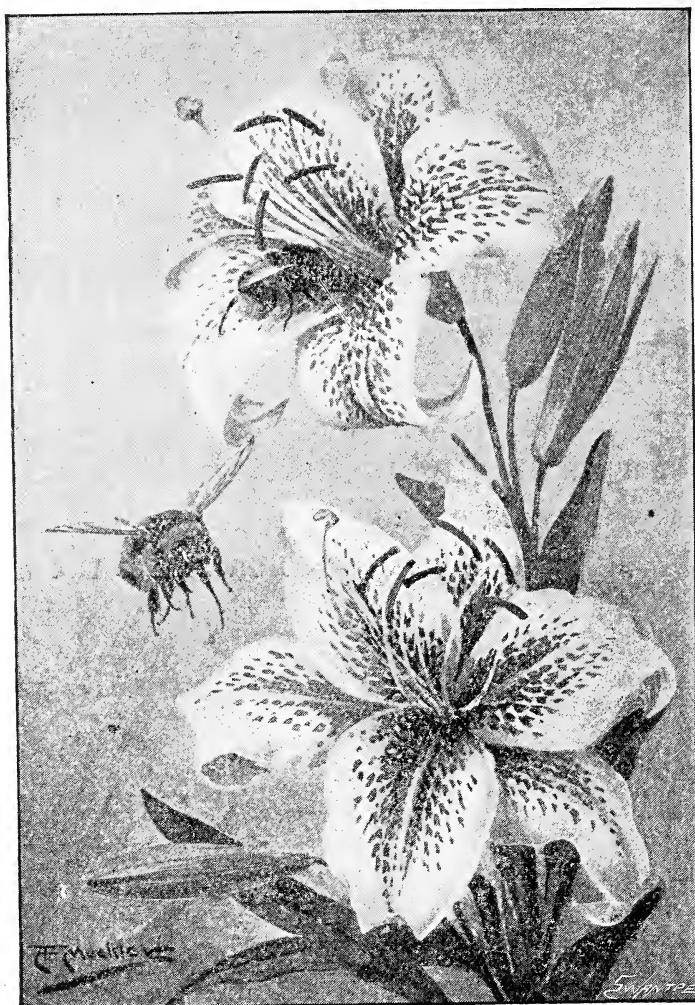
2. In some flowers, such as the lilies and orchids, even the sepals put on gay colours like the petals; as if to help to make sure that the flower shall not go unnoticed by the insects to which it offers its tempting nectar.

3. Some petals are even spotted and marked in such a way that the lines serve as ‘honey-guides’ to the little visitors. At the same time, the sweet juice is stored away where the insect cannot reach it without brushing off some of the pollen, or leaving upon the stigma some that it has brought.

4. You must not think that any one insect feeds on nectar from all flowers. Each form of flower has its own particular visitors. By the growth of hairs on the petals, or by the nectar being far away at

¹ Nicholls' *Tropical Agriculture*, pp. 33, 34.

the end of a long tube, insects that would be unable to do good to the flower either cannot enter it, or,



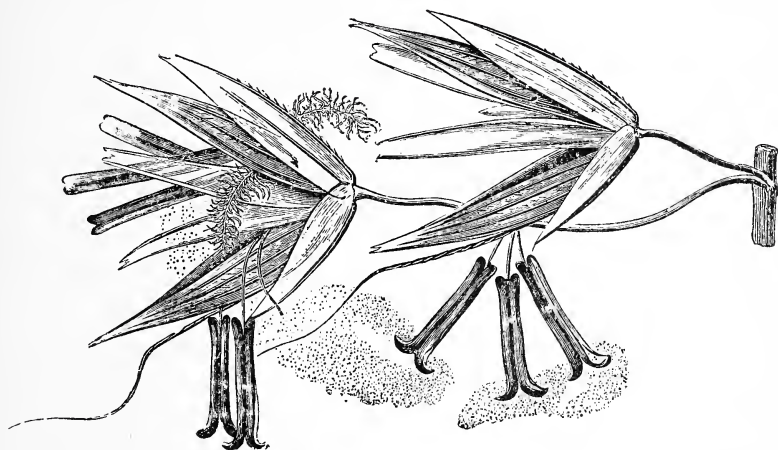
Bees and Lilies.

The spots on the Lilies serve as guides to where the honey is stored.

if they do, cannot rob the flower of its sweet juice. The flower seems to keep that as a payment to those insects that are able to be of use to it.

5. Many of the large flowers in warm countries are visited by humming-birds, sun-birds, and brush-tongued lories, whose long beaks and tongues just suit many of the deep, bell-shaped flowers.

6. But some flowers do not depend upon insects or birds to cause their seeds to grow: they have



Spikelets of Grass in a Wind: the Pollen escaping from the hanging Anthers in the Spikelets to the right.

neither bright petals nor sweet scent, nor any store of honey to attract insects.

7. These flowers mostly have many stamens, which hang out freely on long stalks, and are shaken by every passing breeze. Their stigmas are feathery, and are spread out as if to catch any grains of pollen that may drift towards them through the air.

8. The wind is the friend of such flowers as these. It wafts the fertilizing grains of pollen from flower

to flower, or from tree to tree, though these may sometimes be a long distance apart.

9. Amongst the plants whose pollen is carried by the wind, the commonest are the corn and the rest of the grass family. Examine for yourself the flower of one of these plants, and you will see at once how lightly the dangling anthers hang, and how they seem to tempt the frolicsome breeze to scatter the pollen for them.

SEEDS AND SEEDLINGS.—I.

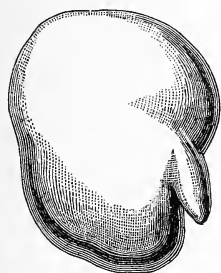
1. If we do not gather the seed it falls to the ground when it is quite ripe, and in time a young plant sprouts forth from it, of the same kind as that on which it grew. It may be that only a short time passes before this growth takes place, or, as in the case of some of the palms, even years may go by before the new plant shows itself.

2. We so frequently see young seedlings springing up, that perhaps we do not stop to think how wonderful it is that soft tender leaves should unfold from the hard seed. Only think of it for a moment, and you will surely be curious to know what there is within a seed, and how a living plant can sprout forth from it.

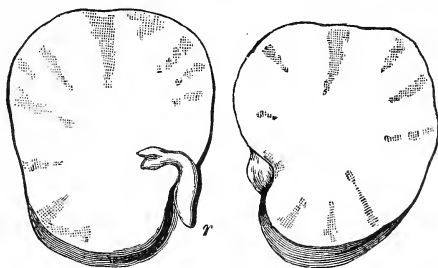
3. It is easy to examine the parts of a large seed, such as a bean or pea. When soaked in water it

softens and swells, so that the double skin which covers it can be easily removed.

4. Then we see that the bean is chiefly made up of two white fleshy portions, filling nearly all the space within the skin. Put a pin between them to force them apart, and then you see a little white body, fixed to both of them, and hinging them together,



Bean, with outer skin removed.



Bean, split in two halves, showing *radicle*, *r*

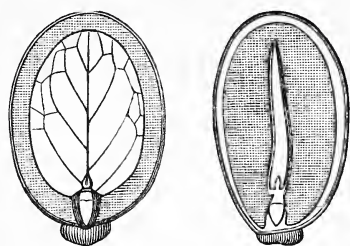
which is really the bud, stem, and root of a baby plant.

5. The upper part of it, curving inwards to the fleshy halves of the bean, is the bud, and in it you may even see the tiny leaves; the lower part is called the *radicle*, and from it grow the roots.

We find, then, that a seed is a living thing, in which rest the beginnings of root, stem, and leaves; it is, we may say, a baby plant slumbering in its cradle.

6. But what are the two thick, white portions between which the bud lies nestled? They are the first leaves of the young plant—"nursing-leaves" we may call them, for they hold a store of food for

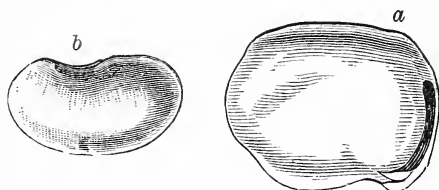
the young plant to feed upon, until its root has grown and is able to obtain food from the soil.



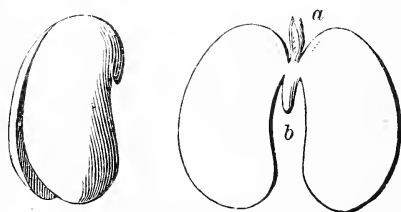
Castor Seed—cut across in two different ways.

7. In all seeds we find food laid by for this purpose. It is not, however, always stored in the seed-leaves; sometimes, as in the white, floury substance of corn, or the oily kernel of the cocoa-nuts, it lies around the baby plant. In

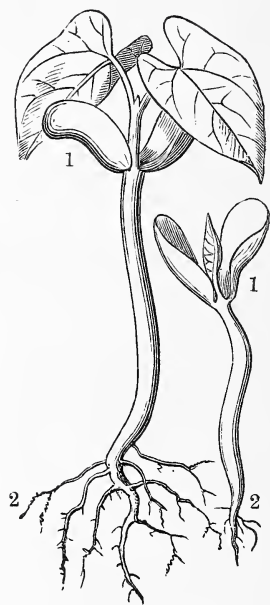
either case the parent plant provides that its offspring shall have enough to feed



Beans: (a) Windsor-bean; (b) Kidney-bean.



Beans with their Seed-leaves opening out.
a, the Plumule. b, the Radicle.



Germination of the Bean Plant
(1) above ground, (2) below ground.

upon until it is able to start life on its own account.

8. Cut open a seed of corn or a castor seed that has been soaked in water, and you may find the

tiny plant, or *germ*, as it is called, amongst the much larger mass of food. Or, place some beans and some corn upon wet cocoa-nut fibre, where you may watch the growth of the young buds and roots. Then you will see the two nursing-leaves (or seed-leaves) of the bean shrink and wither, as their store of food gets used up; and you will discover that the corn, like many other plants, has not two seed-leaves, but only one.

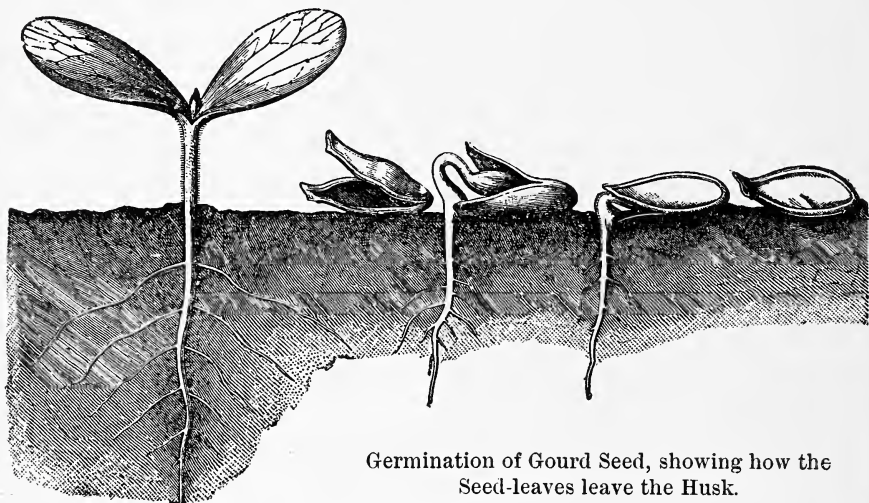
9. You will notice, also, that the radicle of the corn gives out several fibres from its blunt end; while in the bean the radicle itself lengthens, forming a tap-root

SEEDS AND SEEDLINGS.—II.

1. In some seedlings—for instance, in coffee—the growing stem carries the two nursing-leaves up into the air, where they throw off their seed-skin and become green. Then they draw in food from the air to make up for the short supply which they had at first. They are, however, very different in shape from the true leaves that grow afterwards, as may be well seen in the gourd and the mustard.

2. Perhaps you wonder how the baby plant feeds when the store of food lies quite outside it, as in the seeds of the corn, palm, castor-oil, and coffee. In that case the seed-leaf sucks in the food that is packed near it, and in that way the plant is fed.

3. In the seed of the date-palm, the seed-leaf draws in the food at its point, at the same time growing longer and longer. As it lengthens it serves the young plant an odd trick, for it pushes the bud and radicle out of the seed, as you see



Germination of Gourd Seed, showing how the Seed-leaves leave the Husk.

in the picture, though it never fails to pass food along to them until they can find it for themselves.

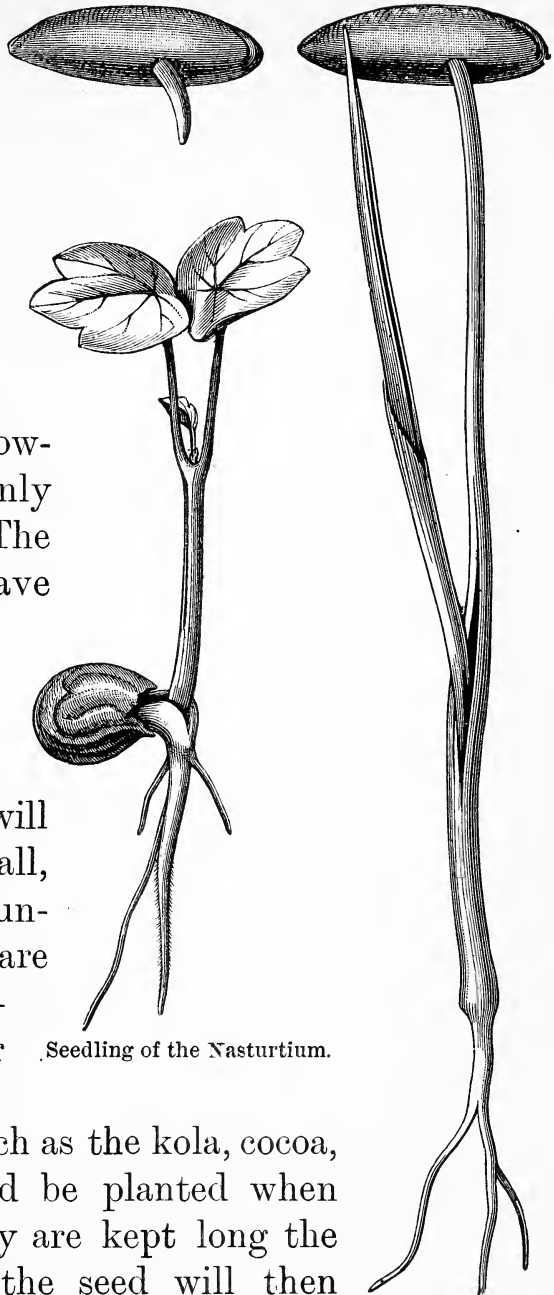
4. In many seeds we find that the starch, oil, or other food that is stored up for the young plant is good food for ourselves. That is why we eat the seeds of the corn and cocoa-nut, or make drink from those of the coffee and cocoa, and why we take the trouble to rear the plants that yield them.

5. We have seen that the seed holds a living plant, resting amidst its store of food. In seeds that are kept perfectly dry the germ will continue

to rest for a very long time; but if the seeds are kept moist they will most likely begin to germinate; that is, the germ will begin to sprout.

6. Moisture, however, is not the only thing needful. The seed must also have both warmth and air. Some seeds require more warmth than others, and many will not germinate at all, except in hot countries, unless they are grown in a plant-house where the air can be kept warm.

7. Some seeds, such as the kola, cocoa, and nutmeg, should be planted when quite fresh; if they are kept long the kernel dries, and the seed will then give no signs of life.



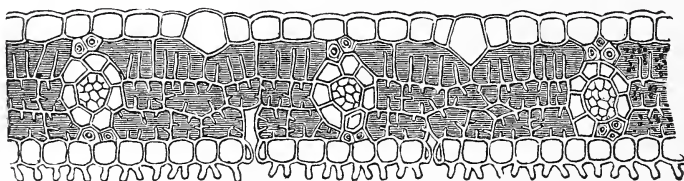
Seedling of the Nasturtium.

Germination of
Date.

HOW A PLANT FEEDS.—I.

1. When the first root has entered the soil, and its root-hairs have grown, and when the leaves from the little bud within the seed have forced their way into the sunlight, the new plant is fairly out in the world and able to supply itself with food.

2. That it needs food we may be sure, because it *grows*, and it could not do that without taking in



Bamboo Leaf cut through, showing Cells. (Very highly magnified.)

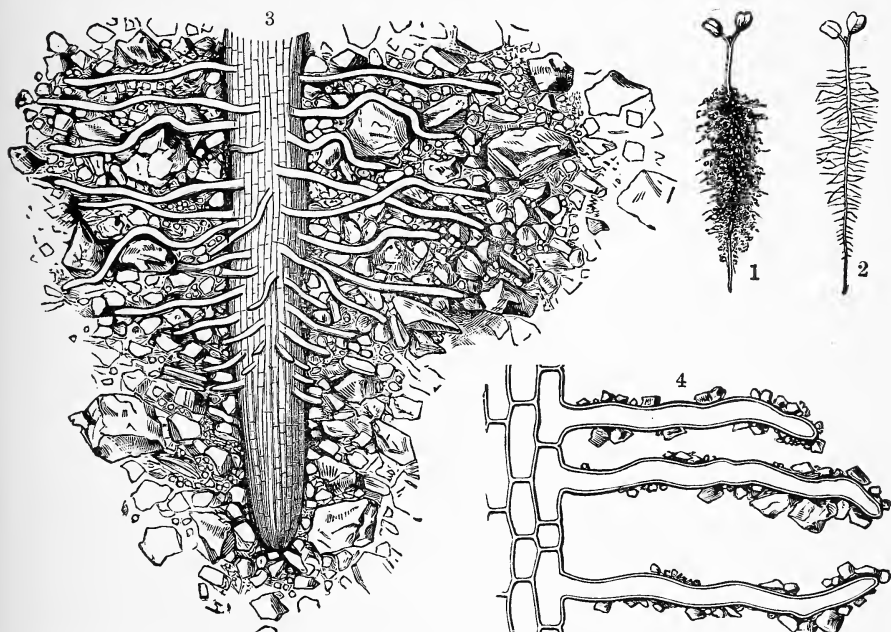
something with which to build up and enlarge itself.

3. Let us try to understand, then, what this food is, and how the plants get it. You remember that the pulp of an orange or shaddock is seen to be lying in a very large number of tiny bags, called *cells*. Now, every part of a plant is made up of cells, though they are very rarely large enough for us to see them with the naked eye, as we can those in the ripe orange.

4. We know that a plant has water in it, for we need only to cut or bruise any part of it to find that it is moist. In some vegetables nine-tenths of

their substance is water, and even the driest kinds of timber have much water in them.

5. This water is held in the cells, whose walls are so thin that it passes through them from one cell to



1, Seedling with soil attached to Root-hairs; 2, the same washed clean; 3, A Root-tip with Root-hairs (magnified); 4, Root-hairs (much magnified) with soil on them.

another. And that is the way the food is carried along.

But how does the food get into the plant? Most of it is taken in by the leaves, and some, besides water, goes in by the roots.

6. On the delicate little feeding-threads of any root, numbers of the cells lengthen out so that they appear like little hairs, and are called *root-hairs*. It is these that gather from the soil the necessary

food and water; but the walls of their cells will not let any solid pieces, however small, pass them. So, whatever food goes in must first be dissolved, just as you have seen sugar dissolve; then it can pass through with the water that holds it. If the water cannot itself dissolve the plant-food, an acid sent out by the little root-hairs does so.

7. But the plant gets a very small share of its solid substance from the soil. If we thoroughly dry a plant, to get rid of its water, and then burn the solid part, most of it will pass away and we shall have left nothing but a small quantity of ash. That ash is almost all that the plant took from the soil, except water.

8. Since the plant takes up so much water from the soil, we might suppose that its cells would at last become so full and swollen that no more could be taken in. But if that happened the water would soon cease to pass along from cell to cell, and the plant would die. So it has a way of getting rid of some of its water to make room for more to come in.

9. The water escapes through the surface of its leaves. It goes away as vapour, which we cannot see, just as the water of a pool in drying up passes unseen into the air. Then, as the water escapes from the leaves, more rises through the roots to take its place, and in that way a constant stream is kept up through the plant. If the roots cannot

procure enough to make up for the loss from the leaves the plant droops.

10. The dissolved mineral food brought in from the soil, however, does not pass off with the water, but remains in the plant, to help in forming fresh growths.

11. Some kinds of plants give off water from their leaves much more freely than others. A tobacco plant will give off nearly a quart a day, and a guango-tree twenty or more gallons daily. Only think what an enormous amount of vapour must be poured into the air from a forest or plantation!

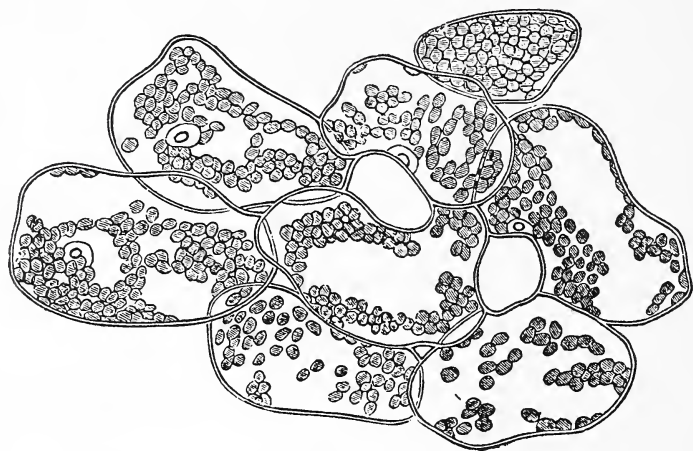
This work is almost all done in the daylight, as at night the little pores in the leaves close.

HOW A PLANT FEEDS.—II.

1. We have already seen that plants take in some food as well as a large quantity of water by their roots; but by far the larger part of their food is taken in by the leaves. This food is a gas, called *carbon dioxide* or carbonic acid, which is always present in small quantities in the air.

2. The leaves spread themselves out, and take in the gas they need through tiny openings, called *stomata*, in the under surface. To understand what happens afterwards, you must know that this gas is made up of two things—of oxygen gas and carbon.

3. Now, in the cells of the leaves there are fine grains which we may call 'leaf-green', because they give the green colour to the leaves. Their proper name is *chlorophyll*, and though a hard one it is worth remembering, because the chlorophyll does such a wonderful work within the plant.

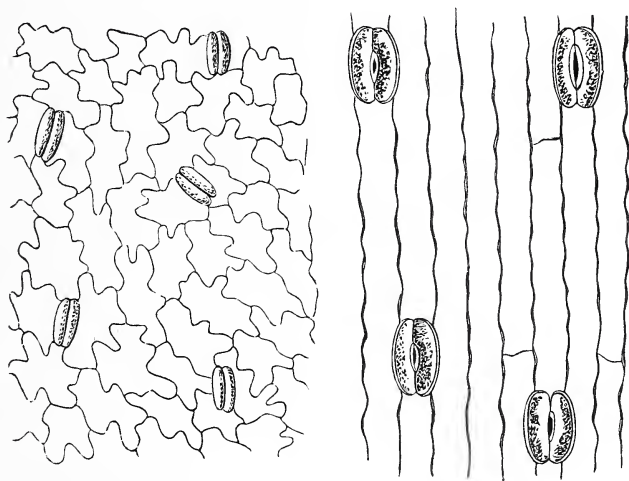


Leaf-cells with Chlorophyll-grains (highly magnified).

4. In the sunlight it makes the carbonic acid break up into its two parts—oxygen and carbon. The leaves then send out the oxygen, but keep the carbon, that they may use it in making starch, sugar, and other substances for the new cells that add to the growth of the plant.

5. It is no wonder that planters are so anxious to see that their crops get plenty of air, by not allowing them to be overcrowded; and that they root up weeds, which might rob their plants of the food near them in the air and in the soil.

6. And there is another reason why plants need air. They obtain oxygen from it as well as carbonic-acid gas, and they cannot live without oxygen any more than we can. That is to say, the plants—in addition to taking in carbonic-acid gas during sunlight, as already described—*breathe* oxygen in



Enlarged views of Leaf-surfaces, showing the pores through which the plant breathes.

and give *out* carbonic-acid gas; and this they do in the darkness as well as in the light. But the quantity of carbonic-acid gas thus given out is very much less than the amount taken in during sunlight.

7. How wonderful it is that from lifeless matter gathered from the air and soil the parts of a living plant can be formed! Plants are the world's great manufacturers of the food upon which animals depend; for, as you know, we and all other animals

feed on the produce of plants, or on animals which have had plants for their food. If, then, there were no plants in the world, neither could there be any animal life.

HOW PLANTS ARE REARED.—I.

1. We have seen that a plant is a living thing, which feeds, breathes, grows, and in time dies. But a healthy plant does not die before it has provided for starting the growth of other plants of its own kind. The commonest way by which it does this is by bearing seeds, in each of which, as we have seen, there is the germ of a young plant, with enough food for its early stage of growth.

2. To give seeds to multiply its kind is the great purpose for which all the work of the plant goes on. Often it dies as soon as it has shed its seeds, leaving them, in turn, to start the same round of life.

3. If, then, we require to raise certain plants for our own use, we often obtain them by sowing seeds. But considerable care is needful; and we shall not get good plants merely by putting seed into the ground. Everyone has seen how plants of the same kind differ in size and in strength. A plant growing on soil that does not suit it is

poor and feeble; and that is most likely the case, too, when it is reared from the seed of a weak and sickly plant. If a planter wishes to raise good crops, he must choose his seed from strong and healthy plants that have yielded a full crop; and even from such plants he should pick the largest and best seeds he can find. In that way he may improve his crop year by year; for plants, like children, generally take after their parents.

4. But it must be remembered that seedlings do not always have exactly the same qualities as the plant from which they come. For instance, though from an orange seed nothing but an orange-tree will grow, this may produce oranges of a different quality from those of the tree which gave the seed.

There are several other ways by which new plants may be raised.

5. Take the yams, for example. As soon as these are fully grown the plant dies, for its work is done, and in course of time new plants sprout forth from the 'eyes' of the tubers. If left in their place they would not thrive well, for they would be too crowded. So we are careful to split up the yam 'head' into pieces, according to the number of 'eyes', and from each piece we thus get a separate plant. These we set out at some distance apart



Bulb of the Lily.

in the ground, that they may have a fair chance to get the air and food they need.

6. In lilies, and other plants with bulbs, several young bulbs appear around the old one, and in that way the plant increases the number of its kind.

7. The strawberry plant has another plan for starting its young ones in life. Along the ground



Strawberry Runner.

it sends out a slender stem, bearing a bud at its end. At some distance from the old plant the bud gives out leaves, while roots strike downwards into the soil. Thus a new plant is formed; and by being a little distance away, it has more chance of getting food than if it were crowded very close to the old roots and leaves.

HOW PLANTS ARE REARED.—II.

1. Some plants send up *suckers*, or young shoots, from stems that have rooted in the ground. In time the underground stem which links the sucker to the old plant dies, and then we have a separate plant, able to get its own living. In this way we obtain young plants from the banana, which seems so satisfied with this plan of giving new plants that it does not produce any seeds.

2. When we dig up a ginger plant we find that its root-stock—whence ‘the hands’ of ginger are obtained—bears a number of buds from which the leaf-shoots grow. If we cut off a piece with a bud on it, and plant it, the shoot grows just as well as it would from the whole root-stock.

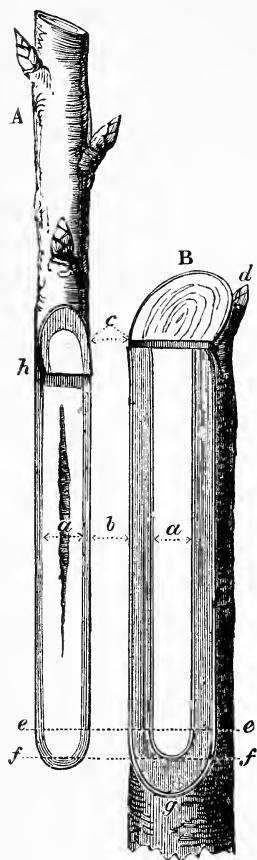
3. This is an easy way of rearing several kinds of plants, such, for instance, as cardamoms, arrow-root, guinea-grass, and many others.

Sometimes a planter cuts off pieces from the stems or branches of a plant from which he wishes to rear new ones, taking care to cut each piece just below an ‘eye’ or bud.

4. He sets the cuttings, as these are called, firmly in the ground; and soon, by giving out roots, they become growing plants.

This is the way that the sugar-cane, bamboo, sweet-potato, and cassava, are generally treated. And it is a good plan; because we may be sure

that plants reared from cuttings will have exactly the same qualities as the stock from which they come.



Grafting.

A, Cutting; B, stock. A sloping cut is made in stock from *c* to *d*, and the cutting is notched at *h*. *aa* are the exposed portions of wood which are fitted to one another.

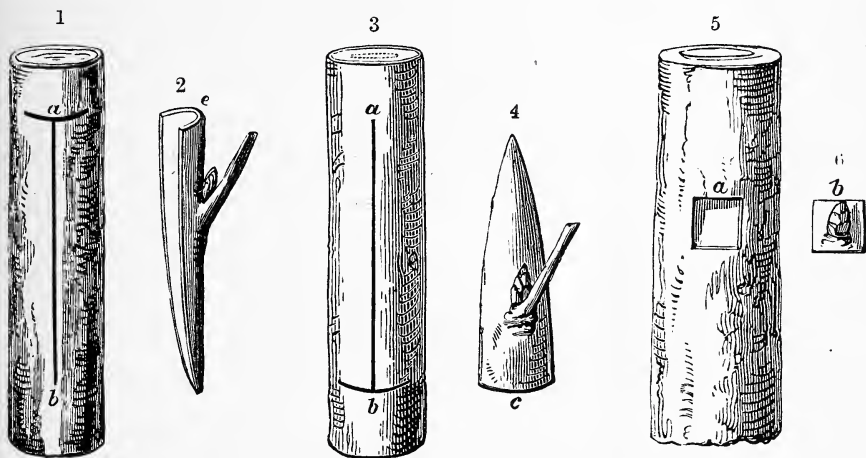
5. Of course we might get a new plant of the sugar-cane or bamboo at once by cutting it away from the root-stock. These well-known plants seldom give seeds; indeed, they multiply so fast by the growth of new shoots, that there is little need for them to supply seeds to keep up their kind in the plant-world.

6. It is possible to cause cuttings to grow in the branches or stems of trees and plants that are already rooted. This method may be carried out either by 'budding' or by 'grafting'; and the old plant on which the bud or the graft is placed is called the 'stock'.

7. Some plants that are difficult to rear as cuttings in the soil, grow readily if budded or grafted. By this plan, too, seedling fruit-trees can be made to bear crops earlier than they otherwise would, and we may be nearly certain of obtaining fruit of exactly the same quality as that given by the tree from which the

bud or graft is taken. Thus we are able to keep up a supply of any favourite variety of fruit; whereas, if we trusted to seeds, we should not be certain of the quality of fruit to expect from the seedling tree.

8. In budding, a bud is cut from a plant or tree, with a portion of bark attached to it, and this is



Budding.

1, 2, T-budding. A horizontal slit is made in the stock at *a*, and a vertical slit at *b*. The bud *e*, which has been cut off as shown, is then inserted in the cleft. 3, 4, Inverted T-budding. Similar to T-budding, but the horizontal slit is made at the lower end of the vertical slit, and the bud is inserted the other way round. 5, 6, Square shield-budding. A square hole, *a*, is made in the bark, and a piece of bark, with an eye on it, *b*—exactly same size—is placed in the hole, any openings being filled up with adhesive plaster.

fixed securely under the bark of another tree, after a slit has been made to let it in.

In grafting, a cutting is set next to the bark, in a stock which has been cut and shaped ready to receive it. The place is then bound round firmly with bast, and well covered with clay to keep in the moisture.

HOW SOILS ARE FORMED.

1. Have you ever tried to think how the soil, which is the standing-place for our plants and a storehouse for some of their food, was first formed, and whence it came?

There was a time, ages ago, when there was no soil on the earth, but all was hard rock. What was it, then, that caused the great change?

2. The work of making and mixing the soil is still going on, and the chief workers are the air, the water, and the changes of temperature.

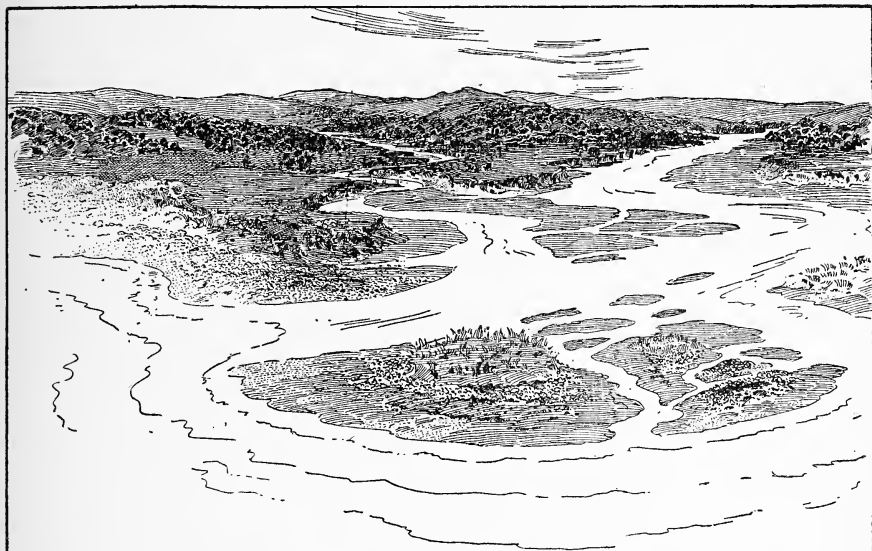
Let us first notice what heat and cold can do.

3. When the ground becomes greatly heated it cracks and splits, causing the particles to press against each other so much that they crumble and fall apart. In countries where it is cold enough for water to be frozen, the ice formed in the soil forces it to split and break up.

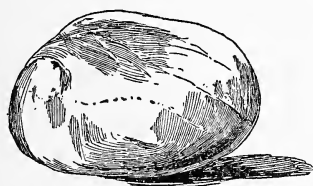
4. It seems strange that lands now in the warmest part of the world were covered with ice and snow long years ago, just as the Arctic regions are now. And the masses of ice, as they slowly slid down the mountains, ground down the rocks, and so took a share in making the soil.

5. When by any means the rocks become cracked and broken they are laid open to the wearing-down work which is done by water.

The rills trickling down the hillsides, or the running streams, roll the broken pieces of rock



Mouth of River, showing Delta, Sandbanks, &c.



Stones worn by the Sea.

Stones from the Bed of a River.

The Work of Rivers.

along, causing them to be worn and ground into gravel, sand, and fine soil; these the water carries

for some distance, dropping them on the plains and valleys, and thus spreading out new soil.

6. The swift rivers carry their mud to be strewn at the bottom of the sea. In many parts, it may be plainly seen that what was once the bed of an ocean is now dry land, which, perhaps by some force inside the earth, has been thrown up above the level of the water.

7. On their way the rivers manage to sort the soil. First they drop the stones and coarse gravel; then, as their speed grows less, they drop the finer gravel; next the sand sinks; and, lastly, the fine mud is carried over the plain by the flood, or is dropped near the river-mouth, or in the sea.

In this way beds of gravel, sand, and clay are sorted out, so as to form soils of different kinds.

8. The waters of the sea, by their constant movements, also wear away the shores and grind them down. We may see that even the hard stones, which have been for a long time rolled about by the water, have had their rough edges worn off, and are round and smooth.

9. There is another way in which water can help on the work of forming soil. It can dissolve some of the substances in the rocks, just as you have seen it dissolve salt or sugar. The water cannot take these substances with it when it 'dries up' or passes into the air. So they have to be left on the earth, and thus they help to form new soil.

Besides, when they dissolve, hollows are left, which cause other parts of the rocks to break away.

10. But what can the air do towards making the soil? I will give you an example. When a piece of iron is left for some time in the air you know that it rusts. That is because the oxygen of the air has joined with some of the iron to make a fresh substance, which you can rub off in dust. In the same way the oxygen or the carbonic acid in the air can act on some substances in the rocks, causing them to be changed, so that they become either crumbled or dissolved, and are then carried away by the water.

11. The great caverns, so common in the limestone hills of Jamaica, show us what a great work the carbonic acid and water can do in this way. The caverns have been hollowed out where quantities of the substance of the limestone rock have been dissolved and carried off.

12. The red clay soil seen in some parts of the island is another example. What was left after the limestone had been washed away has been acted upon by the air, causing changes by which the clay has become red.

KINDS OF SOIL.

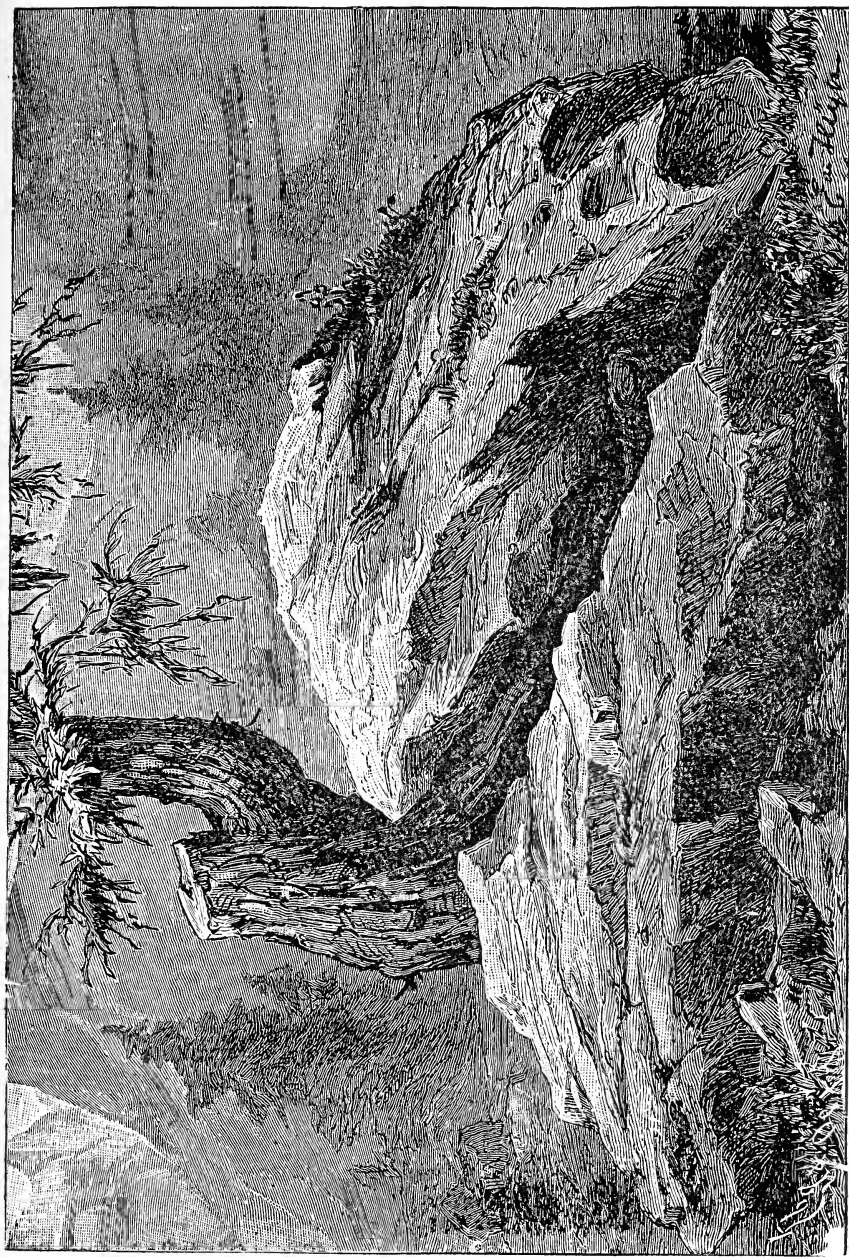
1. You have just read how rocks may be powdered and crumbled to soil, and how this may be mixed

by being shifted from place to place by running water. But this work is not enough to make a fertile soil. There is yet another way in which the soil is greatly changed and added to; that is, by the growth and decay of plants and trees. In their growth these rob the soil of some substances, and in their decay they give back more than they took away.

2. But they do even more than this: their roots enter the cracks and crevices of rocks, and, as they grow larger, they act like a wedge in causing the rock to split and break up. Again, when roots decay, little passages or tunnels are left where they grew, and these make it easy for water to pass through the soil.

3. There are some soils that have been almost wholly made by the decay of plants. Imagine a very wet place, where mosses and water-plants flourish well. These grow and die, crop after crop, until there is a good store of 'leaf-mould' formed by their decay. Then larger and stronger plants appear, and these add rapidly to the new soil, causing it to become deep and plentiful. This kind of soil is known as Peat, and is sometimes spoken of as 'vegetable soil', or as *humus*. Some of it is present in all fertile soils.

4. But what are the soils that are formed by the wearing down of the rocks. From this cause we get clay, sand, and lime or chalk. These mixed



Rock cleft by the Swelling of a Tree Root.

together with stones and humus are what the soils we cultivate are made of.

When we want to describe the kind of soil in our field or garden, we speak according to the quantity of clay or sand in it.

5. If more than three-quarters of it is sand, we say it is a sandy soil, and if, on the other hand, more than three-quarters of it is clay, we say it is a clay soil. Again, should it be nearly half sand and nearly half clay, we call it *loam*. But our garden soil has lime and humus in it. How then shall we describe it? If about one-fifth of the whole soil is lime, we call it *marl*; and if there is a greater proportion of lime it is a chalky soil. It is a peaty soil if a large share in it consists of the decayed parts of plants.

6. And does it matter what kind of soil we have? Yes, indeed it does. For instance, a soil consisting entirely of clay or of sand will not do, for it does not contain the food that plants need.

7. You know why ponds that hold water for any length of time are only found in clayey soils. The water will not easily drain away from them. But it drains away very readily in sandy soils. So it is clear that a clayey soil will be wetter than a sandy soil, which lets the water run quickly through it; and, as some plants thrive with plenty of moisture, while others do best in drier situations, the condition of the soil is of great importance.

MORE ABOUT THE SOIL.

1. We know that there is plant-food in the soil, but we must not think that all the soil is food ready for the plant. The roots can only take in what is dissolved in water, and this is only a very little part of what is in the soil.

2. You may have plenty of uncooked meat in the cupboard, yet you are unable to feed on it until it has been properly prepared for your use. So also the food which the plant needs may be around its roots in abundance, and yet the plant may be unable to use it until the gases in the soil have so changed it that it will dissolve.

3. If we soak some soil in a glass of water for some time, a small portion of what it contains will be taken up by the water. This is the part that is ready for the plants to feed upon. If the same soil be dried, and then soaked again, nothing more will be taken up by the water. But try it after you have left it open to the air for some weeks, and you will then find that the water can dissolve more of it. So the air must have caused changes to take place; from which you learn what a good thing it is to dig and break up the soil, that fresh parts of it may be laid open to the sun and air.

4. But something besides a sufficient supply of plant-food is necessary for our crops. In addition, the soil should be in such a state that air and water

can pass freely through it, and the roots can get to the food.

5. If the soil is very 'loose' and sandy, water runs through too fast, and the plants may suffer from want of it. On the other hand, a stiff clay soil does not let the water drain off fast enough, and then the air is shut out. When that is the case we must not expect our plants to thrive.

6. You understand easily how water can drain downwards, through the soil, but it is not so easy to see how it can rise. A simple illustration will help to make the explanation plain. Every boy knows how readily ink or water spreads through a piece of blotting-paper that is dipped into it, and how a whole lump of sugar or chalk will become wet if only the lower part rests in water.

7. The water rises and spreads through the small spaces or passages between the particles of the paper, sugar, or chalk. In the same way it rises through the spaces in the soil; but it does so best through clay, and least through sand.

8. It rises to take the place of the water which has dried up at the surface of the soil, and in so doing it helps to bring the plant-food round about the roots of the plants.

TILLAGE.

1. Why do men give so much labour to the digging and hoeing of the soil? If we watch them at work, we see that they break up the surface of the land, which has become hard, and they turn up the soil that is hidden beneath, bringing it into the open air and sunlight. What good does their work do, and why will the crops grow the better for it?

There is more than one answer to this question, as you shall find.

2. You know that water and air can act on the soil, so as to form from it food fit for plants to take in. When we disturb its surface, or break up the clods, we let the air and water get freely into the soil; at the same time we loosen the earth, so that roots can easily search about it for food. By burying the upper part, that has been acted upon by the air, we put it where roots will spread; while we bring up the under-soil to take its turn at the surface, where it will be acted upon by the air and sun, and thus made better for the growth of plants.

3. In this way we give the soil a good chance to have more of its substance made ready for the plants to feed upon; and the deeper the soil is tilled the better it is for the plants. This is why we often 'hole' the land before planting. When the top of the soil becomes hard and crusty, the

rain-water cannot enter it freely, and, especially on hillsides, it therefore runs away. Then our soil loses the good that might be done by the water, and by the gases which it washes out of the air.

4. In dry weather the soil may be moistened by water rising from the store that lies below, and if by digging and hoeing we keep the soil free and loose, the water can rise the better. Sometimes, indeed, it 'dries up', or passes into the air too fast, and then, again, hoeing is useful; for, by disturbing the top inch or two of soil, we break up the little passages, and thus prevent the water passing into the air so quickly.

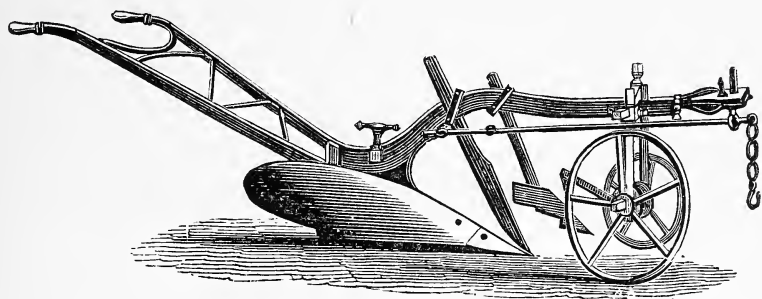
5. The ground should never be left in large lumps or clods, because they dry so hard that young roots cannot enter them, and the plant-food that is bound up in them is therefore lost to the crop. Then, when rain comes, the clods are washed into fine mud which chokes up the top-soil.

6. The spade and fork are the most useful of the tools used for tilling the ground. They dig deeply, and break and mix the earth thoroughly. But where much land has to be turned over, the plough is a quicker and cheaper means of doing the work.

7. The hoe is an excellent tool for weeding, and for loosening the top-soil or drawing it around the roots of plants, but it cannot lift and turn the soil as a spade does.

8. In those parts of Jamaica where the soil is

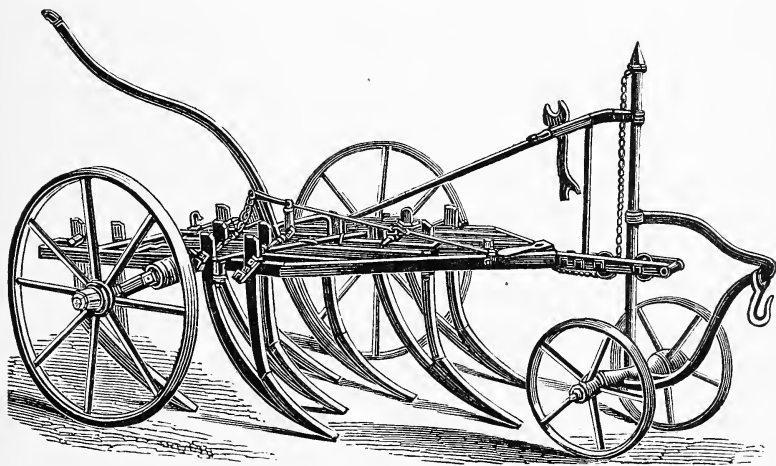
chiefly crumbling rock, the pickaxe proves very useful, for the work could not be done by either



Plough.

hoe or spade. It is a good tool, also, for use in digging holes and in getting at the roots of trees.

9. Besides these tools, we have the cutlass for lopping trees and cutting down bushes and strong

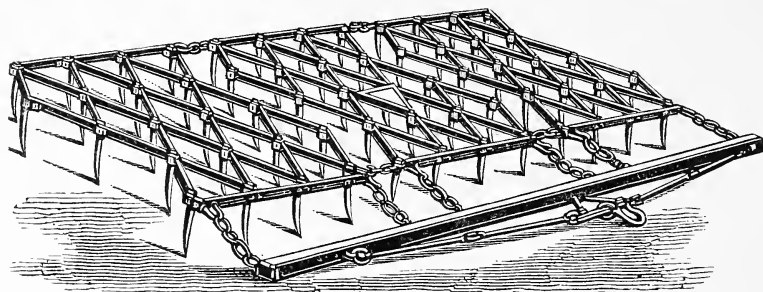


Grubber, or Cultivator.

weeds. We have the rake for clearing up loose weeds and breaking up the surface of the soil; and the digger, or earth-chisel, is useful for holing

ground which is to be planted with cocoa, orange, coffee, and other young trees.

10. Then we have heavy tools that are drawn by horses, cattle, or mules. Of these, the cultivator has large curved teeth, which stir the ground without turning it over as the plough does, and drag out the roots of weeds. The harrow acts like a large rake.



Harrow.

11. Sometimes it is needful for the soil to be pressed. For this purpose we have the roller, which presses in the seed, and makes the top-soil firm and fine enough for the tender roots of small plants.

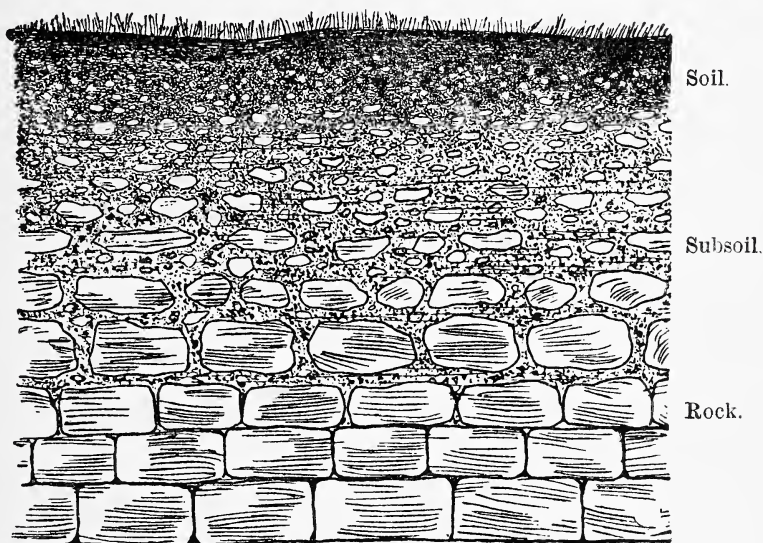
DRAINAGE.

1. When we dig a hole in the ground, we find that at some distance down the soil is not like that at the top. It is neither so loose nor of so dark a colour.

2. The darkness of the top-soil is caused by decayed parts of plants, or humus, being in it. The under-

soil or *subsoil*, as it is called, may be of the same kind as that above it, or it may be part of a large bed of clay, sand, gravel, or some other rock.

3. If the top-soil be chiefly sand or gravel the water can readily drain through it; but with a stiff



Section showing General Formation of Ground.

soil, that will not let the water pass freely, the land becomes sodden.

4. Even when the water has passed into the ground, it may be stopped by the subsoil, and by that means, also, the surface-soil may be kept too wet. You know that if we dig into the ground we find standing water; it may be not far down, or it may be at a great depth; its distance below the surface depends on the kind of soil, and on the

quantity of water that has been poured into it by rain or springs.

5. Although water is necessary for plants at all times during their growth, it must never be allowed to become stagnant round about their roots, if we wish them to thrive. When the soil becomes thus sodden with water, air cannot enter it, and the land then becomes sour and foul, so that most plants cannot use the plant-food that is in it. Besides, much of the sun's heat that would otherwise warm the land is used in drying up the water.

6. It is of little use to dig and loosen the soil to let in air when the spaces are already choked up with water. On the other hand, when water drains away freely through the soil, the air rushes in to fill up the spaces it leaves. Soils are in their best state for growing plants, when air and water have about an equal share in filling the spaces in them.

7. When a soil or subsoil will not let the water drain away readily enough, we should make channels in the ground to carry it off. Of course we do not desire to make the land quite dry, but only to keep the water slowly moving through it.

8. In the hilly parts deep trenches may be dug, along which the water that is soaking the lower parts of the soil may be led off into some stream. Or another plan may be followed, though it is more troublesome and expensive. This is to lay pipes

or tiles underground, in such a way that the water can enter the channels formed by them and thus be carried off.

9. Sometimes, in wet seasons, the earth is drawn up into small hills, in which the plants are grown. In this way we not only increase the depth of soil for them; we also keep it from becoming soaked. It is far better, however, to drain the soil thoroughly. On the steep hillsides, so common in Jamaica, drainage does much good by making room for fresh supplies of rain-water to pass into the land. When the water rushes over the surface instead of entering it, much of the fine, useful soil is often washed down.

HOW WE ROB THE SOIL.

1. In places where the land is not cultivated, as in a forest, trees and plants die and decay on the spot where they lived. On decaying, they give to the soil even more than they drew from it, because most of their substance was built of the carbon their leaves took from the carbonic acid of the air. From the subsoil, too, their roots brought up plant-food which also went towards the growth of the plant.

2. In this way the surface soil is improved, and the remains of the vegetation that grew upon it enrich its store of plant-food.

3. But the case is very different when, year after year, we carry the crops away from the soil on which they have been raised. Whether we take the tubers of yams, the stems of sugar-cane, the trash and ears of corn, the fruits of oranges and bananas, or any other produce, we thereby carry off what the plant worked up from the soil. And of course this leaves the soil so much the poorer. So also, in grazing, sheep and cattle carry off in their flesh and bones the material which the grass drew up from the soil.

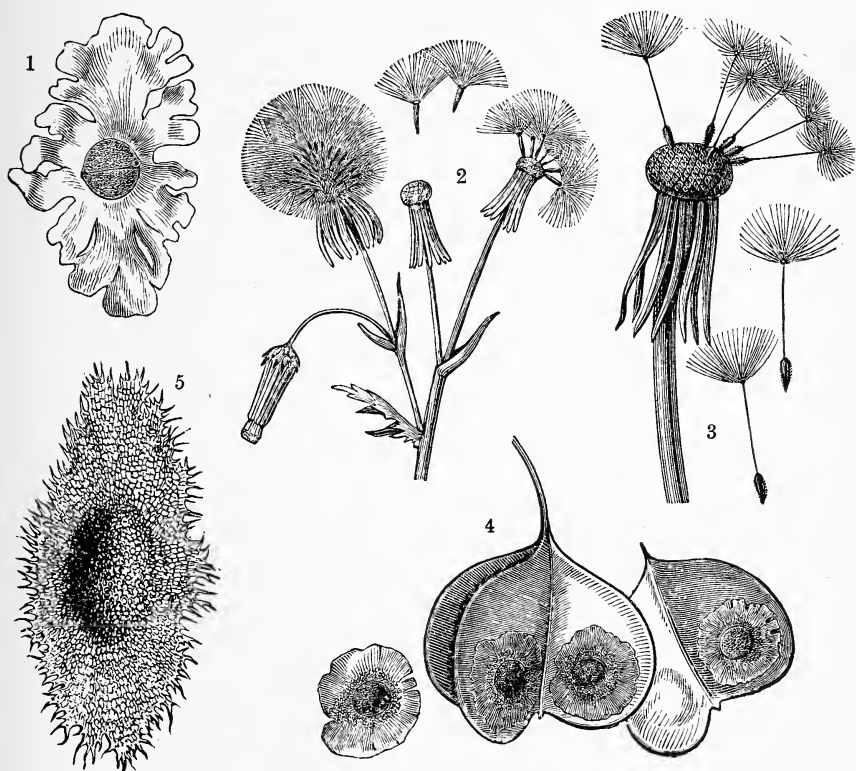
4. Thus, little by little, the soil may be robbed, until it happens that some of the kinds of plant-food begin to run short. Then the plants grow weak and sickly, and are no longer able to yield good crops. When this happens we say the soil is *exhausted*.

5. In Jamaica, when the ground was first cleared for growing coffee or sugar, fine crops were raised year after year for a time. But some of the plant-foods were thus used up faster than a fresh supply could be formed; so that the crops grew poor, and had to be given up for a time.

6. Every plant requires several kinds of food, and if any one of these runs short the plant cannot thrive, although all the other kinds may be within reach in abundance.

7. Suppose you were amusing yourself by threading a large number of blue, red, white, and green beads

in a particular pattern, and that after a time you found your red beads nearly done. By then starting another pattern, which did not use up the red beads so fast, you might go on with your amusement much longer than if you kept to the first pattern.



Wind-borne Seeds.

1, *Bignonia*; 2, *Senecio*; 3, Dandelion; 4, Yam; 5, Cinchona.

8. Now all plants do not take the same share of the various plant-foods. For instance, corn may take from the land a large share of one kind of food, and peas much of another kind.

9. So when a crop has made the land poor in any

kind of food, it is a good thing to make a change, and to have some crop that will require but little of the sort of food which the other used plentifully. Or, such a crop as corn, whose roots search deep in the ground for food, might give place to a crop of cocoas or potatoes, which feed nearer the surface.

10. Plants themselves do something to ensure that their young ones shall not live exactly on the spot where their own growth has been. The new plants are often started at a distance from their parent, at the end of underground stems or runners; or, as in bananas, by the suckers 'throwing' outwards, so that the ratoons grow away from the old plant.

11. Again, seeds are scattered abroad by the wind or by animals; or, like those of the sand-box, are shot away by the bursting pod.

12. In Jamaica, when the land is 'sick' or exhausted, it is the custom to let it become 'ruinate'; that is, to give up tilling it for a few years, and to allow the weeds and bush to spring up. In this way the soil becomes enriched, as in the case of the forest land, so that, after its rest, it is fit to bear crops again.

In the next chapter we shall learn how the land can be restored to fertility in a much quicker way, and even how it may be kept from exhaustion.

HOW WE HELP TO FEED THE PLANTS.

1. As far as possible, we should see that what plant-food our crops take from the soil is given back to it again. If we do not do this, we shall be like a man who keeps on drawing his money from the bank and never putting any in, until at last he has none left.

We therefore sometimes add manure to the soil, that it may help in forming fresh plant-food.

2. As we know the good that is done by plants decaying in the earth, we dig in the weeds, the trash from our crops, the foliage of ferns, seaweed, or any other vegetation that can be spared. This is known as 'green manuring', because the manure is not in a decayed state when we use it. The layer of weeds or trash that is often spread in the coffee-fields of the Blue Mountains not only does good by keeping the ground moist, but also supplies new food by its decay.

3. Sometimes crops of blackeye peas or cow-beans are grown on purpose to be dug or ploughed into the ground as green manure. These plants are chosen because those of the pea-tribe take nitrogen from the air, which most plants cannot do, though they need it in the soil. So, when the pea-plants are dug in they not only give back to the soil what they took from it, but they also carry in a store of nitrogen, which they gathered from the air. In this

way they are of great service, because nitrogen is one of the chief foods that plants must have in the soil.

4. Even better than green manure, though not so ready to hand, is that which consists of the partly rotten straw, or litter, which has been well trodden by cattle and other animals. This kind of manure contains all the substances that plants need. It even holds some food quite ready for the plants, and it will provide much more as it decays in the ground.

5. You know how rotten fruits will cause the sound ones with which they are packed to become rotten like themselves. In the same way the decaying manure acts on what is in the soil, causing changes to take place, whereby fresh plant-food is prepared for use.

6. It may happen that our soil is poor in some particular kind of food, or perhaps that kind has been used up very fast by the crop that has been raised. When that is the case we may help the soil to make up whatever plant-food has run short by using some 'special' manure.

7. Amongst such manures the best known are guano (the dung of sea-birds), crushed bones, and wood ashes. Of course we choose the one that will either supply the kind of food that is needed, or will cause the land to produce it quickly.

8. The green manure or the farm-yard litter, however, does more for the soil than provide it

with what will form plant-food. It also helps to keep the soil in good order, by causing a stiff soil to lie loose and open to the air, and by binding together one that is loose and sandy, so that it becomes able to hold sufficient moisture.

CLIMATE AND PLANT-LIFE.

1. To one who visits the shores of many countries, as a sailor does, perhaps nothing appears more remarkable than the great variety in the kinds of plants in different parts of the world. He may see the hardy pine forests in the North of Europe, the fields of wheat in Canada, of rice in India, and of corn or tobacco in the United States.

2. In the warmth and moisture of the West Indies, and other tropical lands, he may see how magnificent plant-life can become; while in very cold regions of the earth a few mosses and lichens are all the vegetation he can find.

3. Again, if a traveller ascends a high mountain in the tropics, he will pass through varying groups of vegetation, just as he would in a journey from the Equator to countries in the extreme north or south.

4. These great differences are not so much owing to soil, which man can to some extent improve, as to climate, over which man has no control.

5. You must have noticed, even in our little

island, how plants seem to have their favourite spots. The cocoa-nut palms fringe the shore, delighting in the force of the ocean breeze, while some crops need bands of taller trees to screen them from the wind; the sugar-cane or mango flourishes in the warm lowlands, the Blue Mountain coffee in the cooler uplands, and cocoa and nutmegs grow richly in the moisture of shady glens.

6. The life and healthy growth of plants depend upon *light*, *heat*, and *moisture*. These, however, are not needed in the same degree by all plants, whose position on the earth is therefore regulated by the climate.

7. In speaking of climate we consider chiefly heat and cold, drought and moisture, the winds that prevail, &c.; but it is the amount of heat more than anything else in the climate which helps or hinders the growth of plants.

8. Next in importance comes moisture. The mangrove of the swamps and the cactus (or dildo) of the plains show us how widely different are the plants where moisture abounds from those in dry regions. The amount of rain that falls is very great in some parts, while others are rainless; and some countries have their wet and dry seasons regularly, upon which the crops largely depend.

9. Even the moisture present in the air has much to do with plant-life on the soil. At night, when the sun has ceased to pour its warmth upon the

earth, if it were not for the moisture in the air the land would too quickly throw off its heat, and would become so chilled that plants could not endure the great change.

INSECT PESTS.

1. Even after we have done our best by manuring and tilling the soil we often fail to get good crops, because of the damage done by the insects that feed upon them.

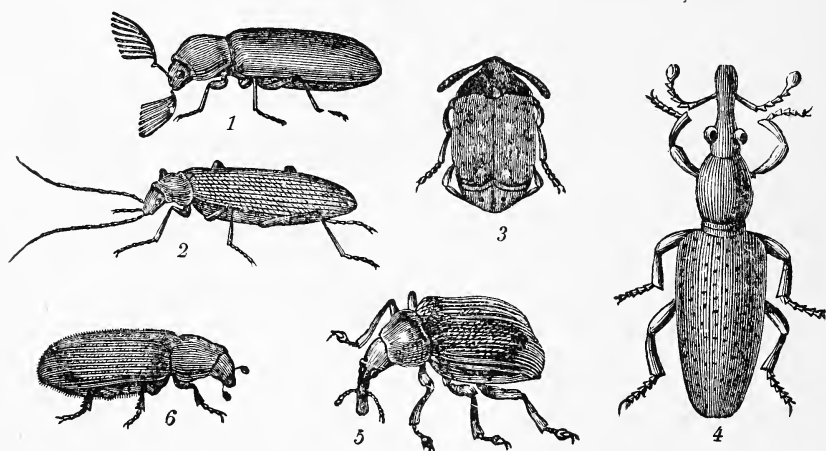
2. Examine any plant, and you will most likely discover some insects that have chosen it for their home. Very often the little animals are carrying on their mischievous work out of sight, within the stems, roots, or seeds. Indeed there is no part that is free from their attacks.

3. Amongst the most destructive pests are caterpillars, or grubs, which are hatched from the eggs of insects, and in due time will change into beetles, butterflies, or moths.

4. In a sugar-cane you may often see the mischief that they do. If you look inside one whose leaves have dried and withered, instead of finishing their growth, you may perhaps discover the cause. Within the pith you may find a little tunnel eaten out, and at the end of it a yellowish caterpillar, or 'Borer', an inch long.

5. How did the caterpillar get there? Its parent, a gray moth, laid her eggs on the lower part of a leaf, near the stem. From these eggs tiny caterpillars were hatched, which at once ate their way into the pith within the stem, and then bored upwards, eating as they went, and stopping the growth of the plant.

6. There are many kinds of borers. Amongst



Insect Pests.

1, 2, Boring Beetles. 3, Pea Beetle. 4, 5, 6, Weevils.

these the weevils are very common, and different kinds of them fix upon different plants. One kind does great harm to the sugar-canes, the palm-weevil bores the roots of the cocoa-nut palm, and for some weevils no seeds seem too hard, for we find them able to bore even those of the date and tamarind.

7. Again, in the stem of the cocoa, the sap-wood of the pimento, and the cured tobacco of cigars and

cigarettes we may sometimes observe the harm that is done by the weevils.

8. Often the caterpillars feed on the green parts of plants; one kind destroys the growing tobacco leaves, another eats the bud of the palm, another prefers to feast on the soft ears of corn, while the coffee-leaf 'Miner' causes the rusty-coloured blotches often seen on the coffee leaves.

9. Very different in appearance from the grubs and insects already mentioned are the numberless Scale-insects that fix themselves on many of our plants. There are five hundred varieties of these insects, and according to their kind, they attach themselves to leaves, bark, or roots, and suck up their juices. They are very small creatures, mostly white, brown, or black in colour; and though very small, they increase in number so fast that they are a pest to be dreaded by the planter.

10. Some of them have a mealy-looking covering, others have a scale over them. The males move about, while the females remain fixed to one spot. It is noticed that they mostly attack weakly plants. On the coffee, orange, palm, and mango trees they are common, often causing the planter great labour and expense in syringing the trees to get rid of them.

11. It would take a long time to tell of all the various pests, such as the ticks, plant-lice, ants, the cotton-stainer, and many others.

12. We have learnt, in most cases, how we may do something towards keeping down their numbers, to save our crops. But the best that we can do would be of little use if we had to trust entirely to ourselves. The fact is we have hosts of helpers. Some kinds of insects feed upon others, and thousands of birds, lizards, spiders, and other creatures are occupied in searching for grubs and insects to devour.

13. Sometimes ticks are the means of spreading certain diseases among animals. If they fall from the bodies of cattle suffering from disease, they lay their eggs in great numbers in the grass, and, when other animals are put into the pasture, the young ticks crawl upon them, and poison their blood, thus causing them to fall ill.

14. It is most important that ticks appearing on the bodies of animals should be destroyed. Old and withered grasses, and decaying vegetable matter of all kinds, form a cover for these pests, and therefore should not be allowed to remain, but should be burnt; and the tick-destroying birds should be protected.

PART III.—CULTIVATION OF CROPS.

A SUGAR-PLANTATION.

1. It was in one of the early months of the year when I saw the men cutting down the ripe canes on Mr. Hood's estate in Trelawny, a parish of Jamaica in which sugar-plantations are common. Indeed, half of the acres under sugar cultivation are in the three parishes of Trelawny, Westmoreland, and Clarendon.

2. The canes were heavy; their dry, brittle skins, gray pith, and sweet, sticky juice, showing that they were ripe. They were plant-canes, which I had seen put into the ground in short slips more than a year ago. Their owner will leave the *stools* for a few years to ratoon, getting, I hope, a good yield of cane each year; and though he will not expect so large a quantity of sugar from the ratoons as from the plant-canes, it will be of finer quality.

3. Mr. Hood had taken great trouble with his crop. He first chose a low-lying piece of rich clayey land that was not too stiff to prevent the water draining freely through it. It was near the sea, but he knew that the canes would not be the

worse for that. As he was aware that his soil had not enough lime to suit the canes, he added some. Then he had the land well hoed and ploughed, and knowing the value of a green-crop manure, he had the weeds buried. He would not allow the men to



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Cutting Sugar-cane.

burn them, for then some of the plant-food in them would have been lost.

4. Next, holes were dug with the hoe, at distances of five or six feet apart, and the cuttings, or 'plants' as we call them, were put in. Mr. Hood had very wisely taken great care to choose his 'plants' from

the best canes that he had, knowing that he had no right to expect his new canes to be fine if he raised them from poor ones.

5. As soon as they had rooted they grew well, and sent up a large number of shoots. Mr. Hood believes in manuring sufficiently to save his soil from exhaustion. Although the plant can get the carbon, oxygen, and hydrogen of which its sugar consists from the air and water, it also requires a share of food that it can obtain only from the soil. So Mr. Hood used what farm-manure he had, and bought some specially made manure, that the land should not run short of the proper plant-food for his sugar crop.

6. His men kept the ground free from weeds that might rob the young canes of food and air, and at the proper time they cleared the canes of dead leaves, to allow the air to move freely amongst them. The trash was thrown on the ground to rot for manure.

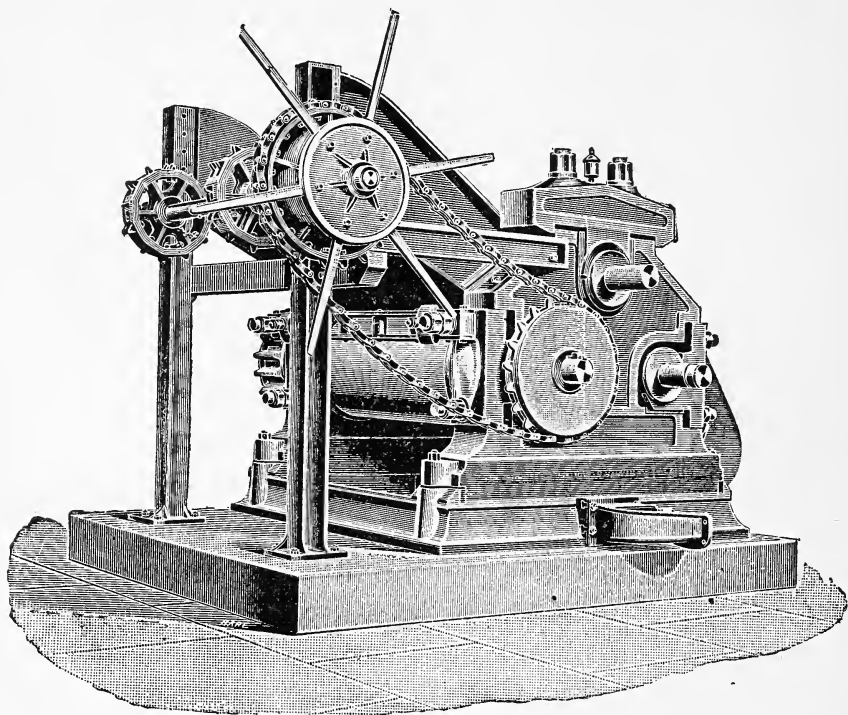
And now, as I see the men cutting down the long canes close to their stools for the mill, I feel glad that Mr. Hood is reaping a good crop in return for all his thoughtfulness and labour.

SUGAR AND RUM.

1. About nine parts out of ten in the weight of the sugar-cane is due to the juice that is in it, and

this consists of more than five times as much water as sugar.

2. There are several kinds of mills for crushing the cane; some with their rollers upright side by side, others having them lying down, in the form



Sugar-cane Crushing Mill.

of a triangle. Of course the object is to squeeze out as much of the juice as possible. But, even with the best methods that are known, not much more than half of the sugar is all that can be obtained.

3. The canes are passed through the rollers twice, and the refuse, or megass, may afterwards be used

as fuel for the engines that drive the mill. The sweet juice is collected in a large cistern beneath the rollers.

4. Now the air acts upon this juice very quickly—so quickly, indeed, that if the liquid were exposed to the action of the air for even half an hour, it would become quite acid and unfit for use. So a little powdered lime is immediately added, and the liquid is then gently heated in pans called clarifiers. This treatment causes a scum to rise which is easily skimmed off, and in that way the impurities are removed.

5. The hot juice is then run into the first of a set of iron or copper boilers, where the heat is greatly increased. As it boils, the water steams off from it, causing it to become thicker. It is then put into the next boiler and made still thicker, and is similarly passed on to the third and the fourth boilers.

6. By the time the juice enters the last boiler it has become a thick syrup. This syrup is then heated, until so much water has been driven out of it that, on cooling, the sugar will form in solid grains. This it does in large open vessels, or coolers, into which it is next placed. With the grains of sugar, however, we get molasses, that is, syrup that does not grain.

7. When quite cool, the sugar is dug out and put into hogsheads with holes at the bottom, through

which the molasses drains off into a large tank over which the hogsheads are placed; or, where machinery can be employed, the grains are freed from the molasses by machines called *centrifugals*, which cleanse the sugar and make it bright and dry.

8. The raw or muscovado sugar remaining is then ready to be shipped, and from it, in course of time, white loaf-sugar will be prepared. Four-fifths of the quantity sent out of the island go to the United States.

9. Jamaica has long been noted for its rum. This is made from molasses and the skimmings of the hot cane-juice, mixed with water and 'dunder'. Dunder consists of the dregs left in a still in which rum has been made.

10. The sugar in the mixture causes it to 'work', or ferment, so that a great change takes place, and the liquid turns thin. After it has been left to ferment for several days it is pumped into a large copper still, which is fixed over a large furnace.

11. As the liquid becomes heated, vapour rises from it, and is collected in pipes which are coiled inside a large tank of cold water.

12. The coldness causes the vapour in the pipes to be chilled, so that it changes into a liquid again. But the impurities have been left behind in the still, and the clear pure liquid we get from the chilled vapour is rum. By adding a little burnt sugar to it we give it the well-known brown colour.

COFFEE.—I.

1. Mr. Hood has had great experience in coffee-growing, and one day he told me the best way to cultivate this crop.



Branch of Coffee Tree—in full bearing.

2. He said:—"A few years ago I helped to manage a coffee estate on the Blue Mountains. It was splendidly situated, nearly 4000 feet above the level of the sea, and of course we planted the Arabian coffee. The Liberian kind, which has been introduced from the west coast of Africa, needs the

rich soil and heat of the lowlands. Though the Liberian coffee-tree grows to a larger size than the Arabian, and bears a larger berry, it does not give such a good quality of coffee.

3. "When we set to work we had first to clear the land of trees and bush. We saved the bush and weeds to rot for manure, and burnt the trees after leaving them for a few weeks in the sun. We worked so as to get ready for planting in the spring, which is the best time.

4. "To provide a stock of young trees we chose out a level spot where the soil was moist, rich, and deep, and there we prepared a nursery bed. In it we planted the seeds, fresh from the berries, a few inches apart; afterwards we took care to keep the young seedlings free from weeds and well watered.

5. "The coffee-tree likes moisture, and does well in a wet climate if the land is well drained. It will not do well on heavy cold clay-soil; and a clay subsoil will cause the trees to die out when their tap-roots reach it.

"We bought a few 'self-sown' plants from a neighbouring plantation, but it is far better to depend entirely upon those raised in a nursery.

6. "Well, as soon as the land was clear we lined and holed it. First we stretched ropes across the ground, and put in pegs near them at equal distances, so that we might plant the trees in rows, and about six feet from each other. This plan is needful for

allowing the air to move freely amongst the trees and the sunlight to enter, as well as for convenience in picking the berries.

7. "Then at each peg we prepared a place for a tree. With a stout iron digger—about three feet long and an inch thick—we broke up the ground round about the peg to a good depth, and picked out all the stones and roots. As the soil on the higher mountains is loose enough to let the water through freely, this plan answered very well.

8. "But if you are about to plant in the lowlands, where the soil is stiff, it is necessary to dig holes nearly two feet wide and deep. For a few weeks these should be left open to the air, that its action on the subsoil may form fresh plant-food. Then they should be filled in with surface-soil, free from stones."

COFFEE.—II.

1. "But I must go on to tell of my Blue Mountain crop. We planted out the seedlings, taking great care to keep their tap-roots straight, and their fibrous roots well spread out.

"Our chief work for a time was to keep down the weeds, for coffee cannot thrive where these are intruding. We mostly used the weeds as a green-crop manure, by burying them in holes dug between the young trees.

2. " Sometimes, when the trees had grown larger, we mulched the ground with the weeds, spreading a layer of them under the trees. This not only helped to keep the ground moist, but also checked



Seedling of Coffee, with Tap-root.

the growth of fresh weeds, and thus lessened the work of weeding, which destroys the fine fibrous coffee-roots near the surface.

3. " As our plantation was in an exposed situation, we planted a shelter-belt of trees to screen it from the winds.

" When the young coffee-trees had grown three or four feet high we topped them, to cause the lower branches to

spread, and to keep the trees low enough for their fruit to be easily gathered.

4. " We had to clear away the 'suckers', as the fast-growing upright shoots that spring from the stem are called, and to prune the trees properly. Many of the shoots are cleared off while they are small enough to be removed by the hand, and this work is called 'feathering' or 'handling'. If all the shoots were allowed to grow, the tree would

become very thick and matted, so that air and light could not get to the centre of it, and the crop would be poor.

5. "We did not use much manure, for it was difficult to take it up the steep hills; besides, our land was very good, and had not been exhausted by previous crops. But, whenever it is possible to get manure from stalls where cattle have been bedded with straw or trash, it is a good plan to dig holes for it near the trees.

6. "It is necessary to be constantly on the watch for the numerous insect enemies that attack the coffee trees, such as the borers, mealy-bugs, scale-insects, and leaf-miners. But the stronger and healthier the trees grow, the less are we troubled with insect blights upon them.

"How we managed when our crop was ready, I will tell you another time."

THE COFFEE-BEANS.

1. At an early opportunity Mr. Hood continued the story of how he managed his coffee-crop.

"It was in the month of May that our berries were red and fit to be gathered and taken to the pulping-houses. Liberian Coffee is not ready until later in the year; the full crops coming in December and the following month, though the trees of this

kind bear berries all the year round, and have heavier crops than the Arabian.

2. "I suppose you know what a pulper is?"

"Certainly," I replied; "it is a machine for clearing the pulp of the berries from the seeds."

3. "A pulper has a rough roller, which crushes the berries as they are passed through the machine," continued Mr. Hood. "Below the roller is a sloping sieve, down which the smashed pulp rolls away, while the beans pass through it.

4. "After leaving the machine, the seeds are sticky with the remains of the pulp; and to cleanse them we placed them in a tank for a day or two, during which time the pulpy matter softened and decayed, so that it could be easily washed away. Then the seeds were dried in the sun on a cement-platform (called a 'barbecue'), until they were very hard and brittle, as good parchment-coffee ought to be.

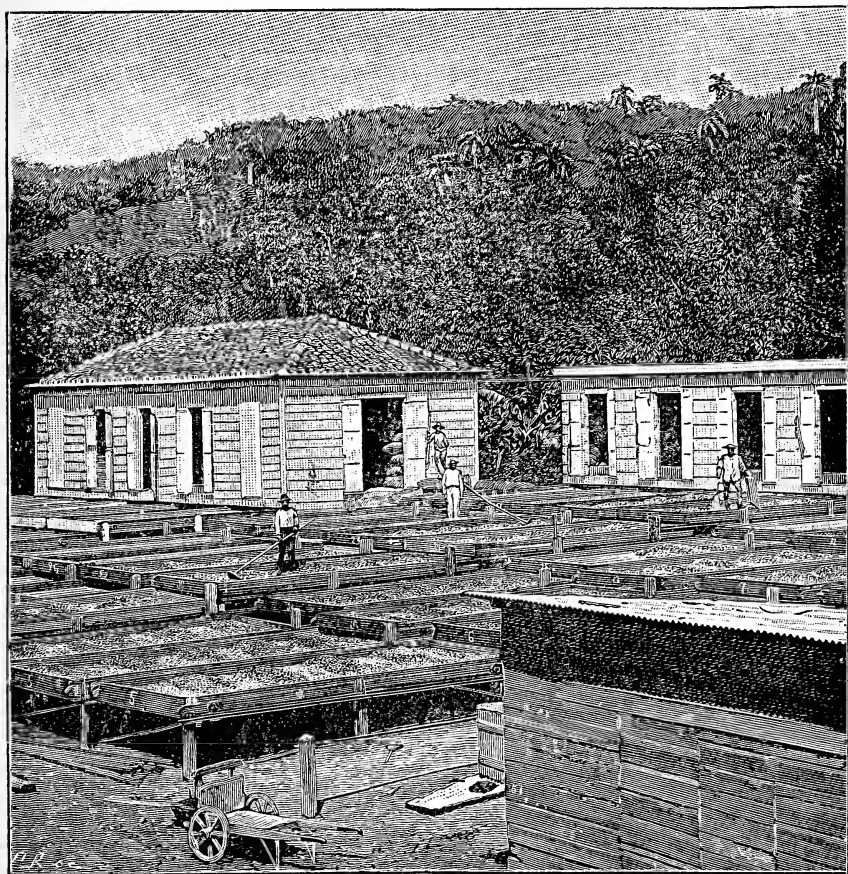
5. "Next we had to see to the 'milling' of the beans, by which we cleared from them, in the mill, both the parchment and the inner covering, or silver-skin. Some planters do not undertake this work, but ship off their coffee in the husk or parchment.

6. "After the milling came the winnowing, by which the broken skins were blown away from the beans."

"So at last you got the coffee for which you had undertaken so much trouble," said I. "There seems

a great deal of work to be done between the planting of the tree and the marketing of the crop."

7. "Yes," replied Mr. Hood; "our work was not over until, by the help of mules and carts, we had



Coffee Drying in the Sun.

sent our coffee to Kingston, where it was packed in casks, ready for shipment to London or Liverpool."

8. "Is it true that the berries are sometimes shipped off whole?" I inquired.

“Quite true,” replied Mr. Hood. “Some people now deal with their crops in that way, first drying the berries well. There are manufacturers in London who prefer to have the dry berries, because they consider that the coffee then turns out better in quality, and they obtain high prices for it.”

THE BANANA.

1. The Banana is one of the most beautiful of all plants, one of the easiest to cultivate, and one of the most productive. In its immense bunches of fruit it yields us a rich and abundant supply of food.

2. Within the last few years the cultivation of this crop has increased very much in Jamaica, which is now the centre of the banana trade in the West Indies, and exports over five million bunches in a year.

3. Most of these are sent to the United States, where, indeed, one kind is generally known as the Jamaica Banana, though it bears special names in most of the West India Islands, *e.g.* the Martinique variety.

Nearly half the land that is planted with bananas in Jamaica is in the fruitful parish of St. Mary.

4. To enable the banana to flourish, it should be rooted in a soil that is moist, deep, and loamy, with plenty of the decayed parts of plants in it.

Young plants are easily obtained from the suckers thrown up by the underground stems.

5. In preparing the land for bananas we must guard against leaving stagnant water, by digging trenches for drainage, if the soil be a very wet one. On the other hand, where the soil does not seem moist enough, we should irrigate it if possible by digging canals to carry water to it.

6. As the large, spreading leaves of the banana require plenty of room, we should not plant the suckers less than about fourteen feet apart on level land, though they may be somewhat nearer to each other on hillsides.

In about a year we may expect to gather our first crop. While the plant is growing, it is usual to leave only three suckers of different ages to grow from its root, to yield fruit at different times after the mother-plant is cut down.

7. A well-known planter, in describing how his bananas were treated, lately wrote: "Each acre was weeded, ploughed, and harrowed seven times during the year; forked around the roots once in the year; suckered regularly whenever the suckers showed." So we see that there is plenty of work to be done. "Without pains, no gains", says an old motto, and no one will begrudge the labour and pains given, when he has the pleasure of gathering in a bountiful crop.

As the fruit very easily bruises, causing decay,

it must be handled tenderly, and cut a week or ten days before it is ripe.

THE COCOA-NUT PALM.

1. Tom and Will were spending the day with their father, and were watching the men as they put out the little seedling palms that were to form a new cocoa-nut plantation.

The land chosen was near the sandy sea-shore; for, as Mr. Jones told his boys, the cocoa-nut palm delights in sea-breezes, and needs either an alluvial soil, near the mouths of rivers, or a sandy soil by the coast.

2. "Almost everywhere in the tropics," he said, "it may be seen fringing the low shores, and bending out towards the sea as if to meet the full force of the breeze from the salt water."

The work of lining the land had been done, and holes had been dug about ten yards apart, ready for the young palms which the men were planting.

3. "Why do you put the plants down so low in the holes?" Tom asked. "Their heads don't even rise to the level of the ground."

"We want to make sure that the palms get a good deep hold of the soil by their roots," said his father. "The holes will get filled up in time, as the plant grows."

4. "How long is it since you made the nursery beds?" asked Will.

"It is a little over six months," replied Mr. Jones. "You remember helping to put the nuts into the trenches which we dug for them, after we had prepared the soil of the nursery bed to a good depth? Then we nearly covered them with earth, and spread a good layer of trash to shelter them from the burning rays of the sun, and to keep the moisture in."

5. "Oh, yes!" said Will, "I remember that; it does not seem long ago. It will be ever so much longer before the palms are big enough to bear nuts."

"I hope they will commence giving us some good crops in five years' time, Will. But, as they grow, we shall have to look out for the scale-insects and the borers; and when the crops appear we must see that the rats don't help themselves; for they are good climbers and fond of the nuts.

6. "We shall soon detect the scale-insects, small as they are; for they will cause the outer fronds, which they first attack, to turn brown, and to wither and die. If we burn the fronds on which the motionless little insects are sucking, and wash the trees with a mixture of soap-water and kerosene, we may keep the pest in check; otherwise the crops will be poor, or the trees may even be killed. The beetle grub must be searched for, or it will eat the

bud at the growing end of the palm, and thus kill the tree.

7. "By the time the trees are in bearing you will both be old enough to help to husk the nuts, and to pack them in bags before they go to the ships, and then to see to the sorting and packing of the coir."

"We have not many 'cocals' in our parish, Father," said Tom.

8. "No," replied his father, "they are mostly at the eastern side of the island, in St. Thomas, Portland, and St. Mary. Indeed, of all the acres laid out in cocoa-nut plantations in Jamaica, eight out of every nine are to be found in those three parishes."

TOBACCO.

1. "We will begin cutting the tobacco next week," said Mr. Burns, as he and his nephew Edward walked through the field one day.

2. Most of the tobacco in Jamaica is raised in St. Andrew (the parish in which Mr. Burns lived), and the neighbouring parish of St. Catherine. But Edward's home was in another part of the island, and therefore he had been living for some time with his uncle, that he might learn how to grow tobacco.

3. "The leaves are very sticky, and their ends snap readily when they are doubled back; by these

signs, as well as by the colour of the leaves and their curling edges, I know that they are ripe," said Mr. Burns. "Do you think you could manage to



Tobacco Plant.

cultivate a field of tobacco yourself, Edward, after having seen all that we have done to raise this crop?"

4. "I should not like to undertake that yet, Uncle. But I know something about it, for I have seen the

work that is necessary. I saw the land ploughed and cross-ploughed, until the weeds were rotten and the soil made loose. And I saw the young seedlings put out, and well remember what a wet day it was. You said it was of little use to plant them during dry weather. Then came the 'moulding up', when the men hoed the earth up to the young plants, until the furrows in which the plants stood were filled up."

5. "Well, go on," said Mr. Burns.

"Then, after the plants had been out in the field five or six weeks, we nipped out the flower-buds, and from time to time we 'suckered' the plants; taking out all the young side-shoots."

6. "And why did we do that?" asked Mr. Burns.

"You said it was to cause the plant to throw all its strength into its leaves," said Edward.

"Quite true. But 'disbudding' would be a better name to give the work of clearing off the side-shoots, for they are buds, not suckers, which we remove."

7. "Then there was the 'worming'," said Edward. "What a lot of trouble the caterpillars gave us! But of course they would have damaged the leaves very much if they had not been caught. I am glad that it is nearly the time for harvesting, for I want to see what will be done in the tobacco-house."

8. "That is a very important part of the work," said Mr. Burns. "The leaves will be spoiled if the curing is not carefully done."

As they walked homewards he said:

9. "When we harvest the leaves we shall follow the Cuban plan of cutting them in pairs, and hanging them over sticks which rest some distance above the ground. By leaving them to wither in the sun, we cause the leaves to become tough when they are handled.

10. "Then we shall carry the sticks with the tobacco leaves into the drying-house, and there leave them for three days. At the end of that time we must put the leaves further from each other, to let the air get amongst them freely to dry them."

11. "And how long will the drying take, Uncle?" asked Edward.

"About a month," replied Mr. Burns. "Then, when the mid-ribs are perfectly dry, we shall strip the leaves from their stems, and put them in heaps to ferment, keeping the 'wrappers', or best leaves, evenly upon each other. After covering each heap with plantain leaves we shall put it into a press, where it will remain for another month. It is the fermentation that produces in the leaves their well-known flavour in smoking."

12. "There will not be much work to do then, Uncle, if you leave the heaps in that way for so long."

"You are mistaken, Edward. Several times we shall have to make the heaps up afresh, changing

the inner leaves to the top or bottom, that they may not ferment too much, and thereby cause decay.

13. "At the end of that time I hope they will be ready for tying into 'hands', or small bundles of five-and-twenty or thirty leaves in each. Then there will be nothing else to do but to pack the 'hands' in boxes or hogsheads, and to send them away.

"We shall have carried out our share of the work then; the rest must be done in the tobacco and cigar factories."

LOGWOOD.

1. Some of our vegetable products are valued because of the dyes or colouring-matter that may be obtained from them.

2. The seeds of the annatto, the root-stocks of the turmeric, and the leaves of the indigo plant are all useful for this purpose. But more important still, in Jamaica, is the value that is set upon logwood, on account of the rich dye that it gives. Large quantities of the wood are shipped from the island, especially from the parishes of Clarendon, St. Elizabeth, and St. Mary.

3. The dye is obtained from the heavy red heart-wood of the trees; and this is cut into logs of a

convenient size, after the bark and sapwood have been chipped away.

4. In manufacturing the dye the logs are first chipped or rasped into small pieces. These are then left to soak in water, which they stain to a



Branch of Logwood Tree.

reddish-brown colour, and from this liquid dyes of many different shades can be prepared.

The best logwood comes from Campeachy, but great quantities of the wood are also obtained in Honduras, Hayti, and Jamaica.

5. The tree is an easy one to cultivate; and so freely does it seed itself, that young ones may be

easily had. Round about the trees the ground generally bears a large number of young seedlings, and when these are a year or two old, the strongest may be trimmed, and left to grow on to make up for the trees that are cut down. Or the seedlings may be transplanted in the wet season to suitable places.

6. In order, however, to improve the quality of the logwood in Jamaica, it is important that, where the trees are grown, a few of the best and healthiest should be saved for the purpose of choosing seeds from them. Sound seeds should also be imported from the best kinds of foreign logwood. It is desirable that nursery beds should be formed for the seedlings, and that these should be regularly planted out at proper distances from each other.

7. If a piece of land be set apart for the growth of logwood, it should be 'holed' at distances of about fifteen feet, ready for the seedling trees. They do not grow to a large size, but are low and spreading, rarely reaching a height of forty feet.

8. We should remember that the substance which builds up the wood of a tree is formed in the leaves, and we should therefore give a tree room to branch to the fullest extent, that its leaves may become large and plentiful. The trees should be thinned out, that the branches of one may not cross those of another, for if they do growth is hindered, and the trees may be thin and weakly.

9. There is little to attend to in cultivating the tree, beyond doing what we can to encourage the trunk to grow large and straight, in order that good logs may be cut from it. For this purpose we trim off all suckers and side-shoots, and, while the tree is young, we cut off some of its lower branches.

10. In about fifteen years the wood may be ready to be felled and cut up, but it will probably improve if allowed to grow on for some years longer.

CORN.

1. America is the home of the corn plant, and enormous quantities of it are now grown in that country, for the sake of the good food it bountifully yields in its seeds. The corn may be eaten either green or ripe, and much of it is ground and prepared into a fine flour, called corn-flour.

2. Nor are the other parts of this fine corn-grass without their uses to us. Their green leaves and stalks serve as fodder for cattle, paper can be made from the sheaths or husks that surround the ears, and sugar from the stalks.

3. In Jamaica the acres of land given up to corn-growing are few, compared with the number set apart for such crops as bananas, sugar, coffee, and cocoa-nuts. The parishes of St. Elizabeth and St. Andrew provide most of the corn grown in the

island; next comes St. Catherine's parish, but in the others very little is grown.

4. It is an easy crop to cultivate, but the soil for it should be deep and well drained, because its roots



Corn.

grow to a great length. In the West Indies the climate best suited for corn is found at elevations of from 200 to 900 feet above the sea.

5. After the land has been ploughed or hoed, and

the soil well crumbled, if necessary, by the harrow, the land should be marked out in squares of three feet. Then, where the lines of the squares cross each other about half a dozen seeds should be sown. This number allows for the weakly plants to be pulled up, as only four should be reared at each point. They will send up suckers near the bottom of the stem, but these must be nipped off, that they may not weaken the plant. Of course weeds must not be allowed to rob the growing corn of its food, and the top-soil must be loosened from time to time to let in air and moisture.

6. Corn, like many other plants of the grass family, to which it belongs, sends down roots from the joints at the lower part of the stem. It is therefore well to 'earth up' the plants; that is, to draw the soil around them with the hoe, so that the new roots from the stem may enter the ground and take a share in drawing up plant-food from it.

7. In about three months the whitened husks and hardened seeds will show us that the ears are ripe for cutting. When that has been done great care will be needful to let the ears get thoroughly dry, either by laying them out in the sun, or by hanging them up in a shed.

The old plan of 'shelling' the corn by hand is a slow and awkward one, and machines are now in general use where much shelling has to be done.

COCO (*COLOCASIA ESCULENTA*).

1. If you were asked to name a few of the most valuable food-plants of the West Indies I am sure you would give the coco a high place in your list. The name in general use in Jamaica for this plant is not a very good one, because it is so nearly like cocoa, coca, and cocoa-nut. In other parts of the West Indies the tubers are called eddoes, or tancias.

2. As might be expected in the case of a plant which gives such useful food, the coco is grown in many countries, and, as is usual with plants that are extensively cultivated, there are several varieties.

3. Both in the leaves and the flowers of the coco there is something remarkable to notice.

The coco belongs to the great class of flowering plants with one seed-leaf, and we should therefore expect to find its leaf-veins lying evenly side by side, as in the leaves of corn and banana. But they do not follow the general rule, and we find them net-veined, like those in the great class of flowering plants with two seed-leaves.

4. Its flowering spike also is well worth examining. We find that it is not a single flower, but that very many small flowers are arranged on the spike, and that those towards the top are very different from the lower ones.

5. It is easy to explain the cause of this difference; the upper flowers have only anthers, the

lower ones only pistils. So we might say that there is a cluster of male flowers above, and another of female flowers below. There are, however, no petals and no sepals. (See picture on page 52.)

6. The coco is a handsome plant, with its graceful heart-shaped leaves raised high on long stalks. These form capital food for cattle and pigs, or the young leaves may be boiled for our own use. But it is, of course, for the sake of its tubers that we cultivate the plant, for in them lies a large supply of starchy food, which it has stored up in such abundance that the tubers often weigh several pounds.

7. The coco has been found very useful as a shade-plant, to protect the seedlings of some of our crops from the wind or sun.

To rear young plants it is only necessary to cut off the head of the root-stock and bury it in the ground, as is done in raising yams. From the head a number of young plants shoot forth, which may then be separated and planted about a yard apart, in land that has been well dug or ploughed.

8. A sandy loam is the soil that suits cocoes best, especially if the remains of decayed plants are plentiful in it. The tubers are yielded in such abundance that nearly a bushel of them may often be obtained from one head.

PART IV.—HEALTH.

WHY WE EAT.

1. May Lewis, whose father had died when she was a baby, was only twelve years of age when a sad trouble came upon her. Her mother, whom she loved dearly, fell ill and died.

2. Then Miss Brooks, who had been May's teacher, and knew that she was a good and thoughtful girl, showed kindness to her, and took May to live at her own home. May was to assist in the work of the house, and Miss Brooks determined to do what she could to help her to grow up a useful and sensible woman. That is why she wished May to gain some knowledge about the foods she helped to prepare and the clothing she wore.

3. "Surely there is nothing that concerns us more than the health of our bodies," Miss Brooks would sometimes say. "For if we do not keep our bodies in good order by proper food and clothing, and by fresh air, we make our lives less happy and useful than they might be."

4. "Miss Brooks," said May one day, "I have found out from the book you gave me why we eat food."

“Well, tell me why.”

5. “Food causes our bodies to grow, and makes up for the waste that is always going on,” said May. “But that is not all; it also gives us warmth and strength.”

6. “That is quite right,” said Miss Brooks, with a kindly smile. “Then you have found out that



our foods serve us as *flesh-formers* and as *heat-givers*. Our bodies have often been compared to a steam-engine that does work, and our food to the fuel that gives it the power to do the work.”

7. “Yes,” said May, “my book says that. But I cannot understand it.”

“Well, perhaps I can make it clear,” was the reply.

8. “In the first place, if we stop feeding the

engine fire with fuel there is soon no steam from the boiler, and then the work ceases. So, too, your body would soon cease to live and have power if it were not fed.

9. "Again, the engine needs repairing sometimes. The parts and organs of your body are also constantly wearing out, and this wasting or wearing has to be made good or repaired every day by the food you take."

"The engine must have water too, and so must we," said May. "I have read about a traveller who died in the desert for want of water."

10. "Yes," said Miss Brooks. "Besides, there must be a good draught of air to the fire. And, for the slow burning of the food in your body, you are fed by the oxygen of the air you breathe into your lungs.

"Of course," she continued, "what we eat must contain whatever is in the flesh, bone, blood, and nerve of our bodies. We must give back the same kind of substances that are wasted or lost.

11. "Now, our bodies contain much water, and plenty of this is therefore needed. We not only take it as a drink, but it is present in all the foods we eat. Then, our bones are partly formed of lime, and other minerals are also found in the body. So we must take in a supply of all these materials.

12. "At present I will say no more about the



The Skeleton.

water or the mineral foods, but I should like to teach you something about the flesh-formers and heat-givers that are in our foods.

“You must not make the mistake of supposing that an article of food can serve only one purpose. It may contain both what will form flesh and what will give warmth, as well as small amounts of water and minerals.”

13. “My book says what the substances in the body are mostly made of,” said May; “but I think the names are very hard.”

“Read them to me,” said Miss Brooks.

14. So May found the place, and, with a little help, read out the words: “*carbon, hydrogen, oxygen, and nitrogen*”.

Then Miss Brooks took the book and showed May the list of the chief minerals that are also in the body. The names in the list were *salt, phosphorus, sulphur, potash, and iron*.

HEAT-GIVING FOODS.

1. “May,” said Miss Brooks the next evening, “watch what I am about to do. I am going to put some corn-flour and some sugar on this hot shovel, which I have placed over the fire.”

May wondered, and watched. Soon she cried out, “They are burning!”

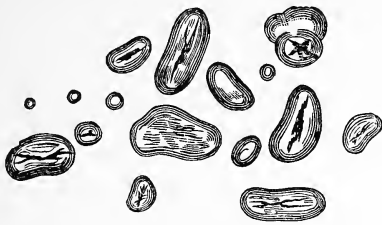


Fig. 1.—Starch Grain—Bean Flour.

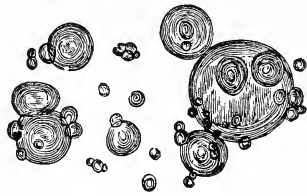


Fig. 2.—Starch Grain—Wheat.

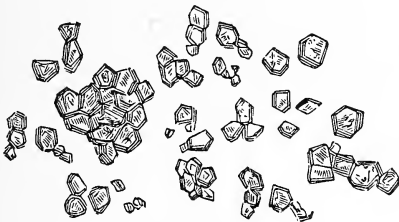


Fig. 3.—Starch Grain—Rice.



Fig. 4.—Potato Starch Granules.



Fig. 5.—Bermuda Arrow-root.

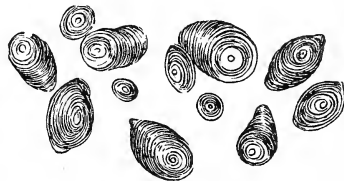


Fig. 6.—Port Natal Arrow-root.



Fig. 7.—St. Vincent Arrow-root.

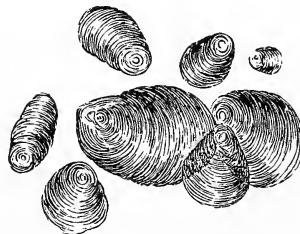


Fig. 8.—Tous-les-mois.

2. "That is just what I want them to do," said Miss Brooks. "Do you see how black they are turning now. They are as black as the charred piece of wood that has fallen from the fire, and for the same reason, for they contain the same kind of substance as that which burns in the wood."

3. "And what is that, please?"

"It is carbon—one of the names you read out to me yesterday. Don't you remember the list? Carbon, hydrogen, oxygen, and nitrogen.

4. "Now the corn-flour is really starch, and neither starch nor sugar has any nitrogen in it. They are both heat-giving foods; the foods containing nitrogen are the flesh-formers. So I think the difference between the two kinds is easy to understand.

5. "I want to talk with you just now about the heat-givers. They are called *carbonaceous* foods by some people, because they have so much carbon.

"I must tell you that our blood is of the same heat whether we live in a hot or a cold country; the inside of our bodies is warm even when we feel cold. This warmth is made by the slow burning of the carbon foods which we eat."

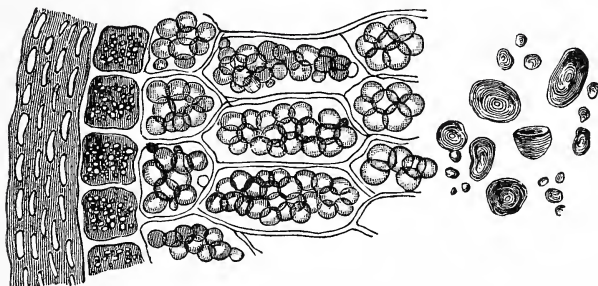
6. "I did not know that we ate starch," said May.

"Indeed we do!" was the reply. "It is one of the commonest of the heat-giving foods. We eat plenty of it in arrow-root, tapioca, rice, and corn, as well as in yams, cocoes, and other vegetables.

7. "If you tie a piece of grated yam or cassava in a muslin bag, and then wash it well in a glass of water, you will find that the water becomes milky in appearance. This is because of the starch which washes out of the yam, and it will settle to the bottom in a fine powder if you leave the water at rest for a time."

8. "I shall try to find the starch in some of the foods in that way," said May.

"Do so, by all means. If we had a microscope



Section of Wheat Grain—highly magnified. To the right the granules of wheat starch are shown more highly magnified.

we should be able to see that the starch powder is made up of little grains, marked with rings; so that starches from different plants are known by their shapes and markings.

9. "As for sugar, it is present in the sugar-cane, the beet-root, and the sugar-maple, in many fruits, and in milk.

"Neither starch nor sugar can form flesh and muscle. Instead, they slowly 'burn', and in doing so give out heat. This is also true of fats and oils

in foods, only these give out more than twice the heat that starches and sugars give."

10. "I suppose you mean the fat in meat," said May. "But what can the oils be?"

"Well, you know that some kinds of fish are oily," replied Miss Brooks. "But we also get much oil in vegetable foods. For instance, the olive and the cocoa-nut yield it plentifully, and it is also to be found in corn and many other seeds."

11. "Have you told me about all the 'heat-givers', as you call them?" asked May.

"Not quite," said Miss Brooks. "But I have told you the chief, and as many as you are likely to remember just now.

12. "I will only add that food containing much starch ought to be well cooked before it is eaten. Cold water will not burst or dissolve the tiny starch grains; but when the starch is baked or boiled the grains swell and burst open, forming a kind of jelly. In that state they are best for us, because they are then easily digested."

FLESH-FORMING FOODS.

1. Before many days had passed Miss Brooks said that May must learn something about flesh-forming foods.

"You will remember," she said, "that I told you

flesh-forming foods had *nitrogen* in them, as well as carbon, oxygen, and hydrogen."

2. "Yes," replied May, "but you did not tell me what nitrogen is."

"Did I not? Well, there is always plenty of it around you although you cannot see it. It is a gas which is in the air we breathe. Nitrogen is also present, combined with other substances, in many of our foods and in our bodies."

3. "Will you tell me what to eat to form flesh, please? for you know that I want to grow and become a strong woman."

"If you learn what some of the nitrogen foods are, you will be the better able to judge what to eat," was the reply. "Sit down and read this passage to me." And Miss Brooks put an open book into May's hands.

4. Then May read:—

"There are several flesh-formers, or nitrogen foods. Perhaps the most important of them all is *albumen*, which you already know well, though not by this name. It is the jelly-like substance found in the white of eggs.

5. "Another flesh-former is called *casein*, and is the cheesy, curd-like matter found in milk.

"Another is called *fibrin*. You may see it forming in a solid state in blood that has drained from any animal.

6. "There is something very much like it, called

gluten, in corn, wheat, and other grain, or known as *legumin* in peas and beans.'

"What a lot of hard names!" said May, as she came to the end of the passage.

7. "Yes," said her mistress. "It is well to know them; but it is even more important to know what they do for us in our bodies. They all serve the same purpose in nourishing the body; though they do not all digest equally well.

8. "The great point to remember about them is that they all have about the same share of nitrogen; so that the gluten of the corn, or the legumin of the bean, is nearly the same thing as the fibrin in the animal or the albumen of the egg.

"The next point is that the nitrogen foods, when they have been digested in the stomach, are taken up by the blood, from which they pass to the flesh, thus adding to its growth and repairing waste of muscle."

9. "And that is why they get the name of 'flesh-formers'," put in May.

"Of course. And their work of flesh-forming cannot be done by the heat-givers. But they, like the latter, give some heat to the body, and some of them make a little fat too.

10. "The flesh-formers are found, as you read just now, both in animal and in vegetable foods. We often make use of them when we eat such food as corn, yams, cocoes, beans, and fruits; or meat,

poultry, fish, eggs, and milk. But they are more plentiful in some of these articles than in others."

A FEW COMMON FOODS.

1. Miss Brooks had many other talks with May about the different kinds of food. There is not space in this book to tell all that was said, but you shall read the facts which Miss Brooks tried to teach May.

First they talked of the vegetable foods.

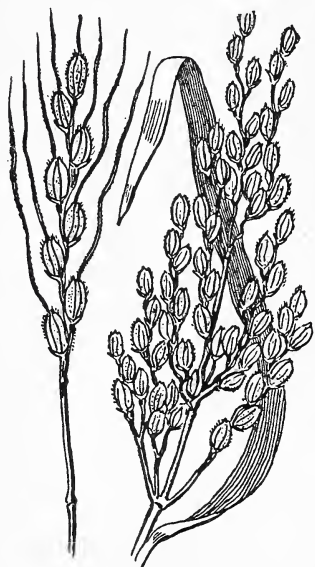
2. Yams and cocoes, which are commonly eaten in the West Indies, contain great quantities of water and starch, and very much less flesh-forming material. Therefore we have to eat a large amount of these vegetables to get as much as we require of the part that goes to form flesh. And, in consequence, the stomach often receives too much, so that it cannot do its work properly, and then the food does not get well digested.

3. Corn is remarkable amongst the grain foods for having a large share of oil or fatty matter in it, as well as abundance of starch. It also contains the flesh-former, gluten, and is a very valuable article of food.

4. Rice, which is eaten in immense quantities in many hot countries, has more starch than any other kind of grain. But it is very poor in gluten, and

should therefore be eaten with milk, or with something else that is rich in flesh-forming food.

5. Peas, beans, and lentils are sometimes called 'pulse'. They are very rich in nitrogen, and therefore are good flesh-formers. But as they have not much oil or fat, it is best to eat fatty foods with them. In favour of pulse food, we may notice that one pound of it contains as much nitrogen as three pounds of meat; but against it we must add that it is not so easily digested as meat. Therefore, when it is used it should be very thoroughly cooked.



Head of Rice.

6. The fruits of the banana, plantain, and bread-fruit add abundantly to our stores of food. While unripe they contain a large supply of starch, which changes into sugar as the fruits ripen. But they are poor in flesh-formers, and in this respect remind us of the rice.

7. There are some vegetable foods in common use which are nearly all starch; the gluten which was mixed with it in the plant having been taken away. Amongst such foods are arrowroot, from the root-stocks of the plant; sago, from the pith of a palm; tapioca, from the tubers of cassava; corn-

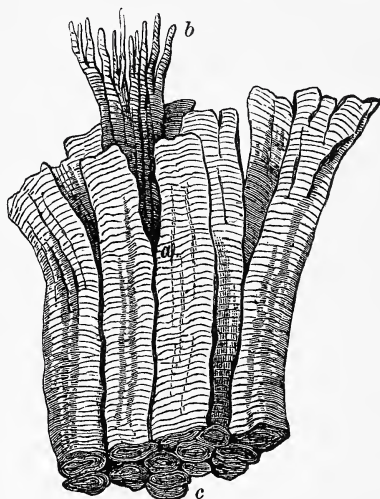
flour, from the seeds of corn; and tous-le-mois, from the root-stocks of the canna.

8. To force a man to live on nothing but these starch-foods would be to condemn him to death by slow starvation; for, of course, he would not find in them the flesh-formers that are necessary. But, as they are very digestible foods, they are often good for invalids.

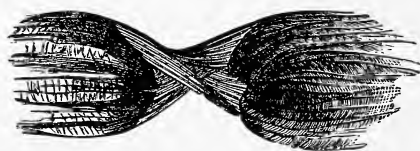
9. The animal foods mostly eaten are beef, mutton, and pork; poultry, fish, milk, and eggs. Though it is well that this kind of food should form a part of our diet, it is possible to keep up life and strength without it, by a proper choice of fruits and vegetables.

Animal food is good for us because of the large share of flesh-formers in it. It also has the heat-giver, fat, as well as a large quantity of water.

10. With the help of the microscope we find that



Portion of a Voluntary Muscle—showing its plan of structure. *a*, A fibre. *b*, The minute threads of which a fibre is formed. *c*, Ends of the fibres.



A highly magnified view of a fibre of Striped Muscular Tissue, with its inclosing sheath of *Sarcolemma*. In this case the fibre has been torn, and the torn ends separated, but the delicate and elastic sheath still stretches between them.

a piece of lean meat is made up of fibres, which are bound together in various ways to form muscles.

Weight for weight, beef is more nourishing than either mutton or pork, but it is not so easily digested as mutton.

11. Sometimes animal foods, especially fish, are salted, to preserve them until they are needed for use. It is very convenient to be able to do this; but the salted meat or fish is not so good for us as the fresh, because the salt hardens the fibres, and it also draws out much of the juice, so that we thus lose a portion of the food.

12. Milk has been called a 'model diet', because it contains, in proper amounts, the four classes of foods needful for health and growth in early life. It has the flesh-former, casein, and the heat-givers, fat and sugar, as well as some mineral matter, and a very large proportion of water. Although grown-up persons need a change of diet, an infant needs no other food than milk.

THE BEST KIND OF DIET.

1. "After all that we have talked and read about foods, can you tell me why we take so many different kinds, instead of fixing upon one we like and eating only that?"

This was the question that Miss Brooks put to May one day.

2. "Oh, yes, Miss Brooks, I am sure I can answer that!" replied May. "A single food—except milk for babies—would not do, because it would not have the flesh-formers, the heat-givers, the salts, and the water just in the amounts that we need."

3. "You are quite right, May. If we were fed upon one kind of food only, we should soon not only lose any appetite or desire for it, but should actually dislike it; and, even, if we continued to swallow it, our stomachs would cease to be able to digest it well, and we should become ill."

4. "If we eat too much of either starchy food or flesh-forming food, what is not needed for warming our bodies in the one case, or for repairing them in the other, is wasted or else turned into fat."

"I do not care much for eating meat," said May. "I like yams and cassava and bananas much better."

5. "That is mostly the case with people who live in warm countries," said Miss Brooks; "but if you lived in the polar regions, you would crave for the blubber or fat of the seal and whale. So you see that the climate of a country has much to do with the sort of food that is most commonly taken."

6. "If we were fed on nothing but heat-givers, such as pure starch, sugar, or fat," said May, "I know we should not live long, because there would be nothing to make up for the wearing away, which you say is always going on within us."

"Neither should we be likely to live long if we

ate nothing but albumen or gluten or other flesh-formers," said Miss Brooks.

7. "Fortunately, most of the things we eat contain both flesh-formers and heat-givers, though not in the exact proportion that our bodies need them. This is the reason why we should not thrive if we kept entirely to yams or to fish, or to any other single article of diet. We arrange that what is short in one food shall be made up by another. So we take fish or meat with the yam, fat meat or butter with beans, milk with rice or tapioca, and so on.

8. "There are some people who think that we need not eat animal food at all, because the vegetables and fruits contain all the food-stuffs that we require, many of them having as much flesh-forming matter as lean meat has."

"That plan suits me, as I do not like meat much," said May.

9. "But you must learn that a food does not nourish us exactly according to the quantity of flesh-forming matter it holds, but according to how much of that is digested and made fit to pass into the blood. The great value of animal food is that from a small quantity of it our bodies get a good supply of flesh-forming material. It is true that vegetables give us what flesh-formers we need, but they are not always easy to digest.

10. "In any case, if we feed entirely on vegetables,

we have to eat a greater quantity than if we take a small share of animal food with them. And then some parts of the body are likely to be overworked, in getting rid of the large amount of food that is taken in.

11. "On the other hand, it is equally unwise to eat more animal food than we really need, and thus overburden the stomach with too much flesh-forming substance to digest.

"So I think you will agree that, for more reasons than one, it is best for us to have a 'mixed diet'."

WATER.—I.

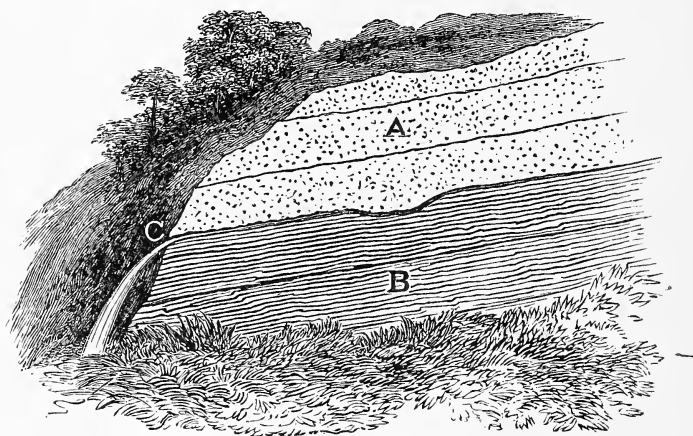
1. One day Miss Brooks said to May: "I think of taking you with me to hear a lecture which a gentleman in Kingston intends to give upon 'Water'. As he is a doctor, and understands what is necessary for our health, I am sure you can learn more from him than from me."

2. May was delighted to go, and the lecture interested her very much. The lecturer began by speaking of the sources from which we get water. He said: "Our supplies of fresh water are obtained from the rain, from springs or wells, and from ponds, rivers, and lakes.

3. "Rain-water is very soft; that is, there is no lime in it, as there often is in water that has soaked

through the soil. In the open country it is generally pure, but in large towns it is often unfit to drink, because of the impurities which it washes out of the air.

4. "When it falls on the ground much of it soaks in, and in time reappears in springs. But in its passage through the soil it either dissolves, or



Section of Hillside.

A, The upper part of the hill—limestone—through which the rain-water passes.
B, The clay below, through which the water cannot pass, and upon which it flows to, C, The spring, or place where the water breaks forth from the hill.

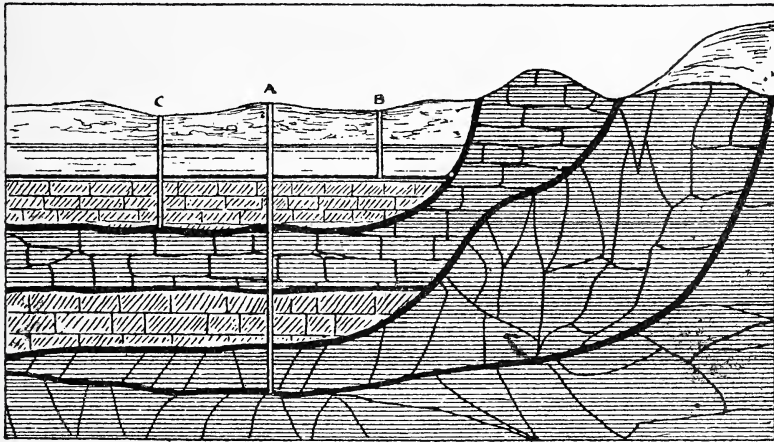
carries along with it, some of the earthy matter. If it passes through chalky soil it is sure to dissolve some of the lime, and then it becomes 'hard'. As a rule, spring-water, although hard, is excellent for drinking, though not so useful for washing purposes as the soft rain-water.

5. "Sometimes wells are dug. If these are only a few feet deep, the water they collect is very likely to contain impurities, which it gathers from the

plant and animal matter that is decaying in the soil.

“The best wells are those that are bored deep through the subsoil until water is reached. The water from these is always wholesome.

6. “Rivers and lakes yield us a supply of very good water, if they do not become fouled by decay-



Artesian Wells.

The wells at A, B, C tap layers of water at different levels—shown by the heavy black lines.

ing matter. In the upper course of a river the water is mostly wholesome and pleasant. But in the lower lands, when it has drained over the surface of cultivated fields, or received the refuse of dwellings and cattle-pens, it is not unlikely that illness may be caused by drinking it. The movement of the running water, however, helps to allow the oxygen of the air to purify it.

7. “The danger of illness is especially great where

people drink the water of stagnant ponds. Instead of using such bad water, they should take the trouble to get tanks in which they may store up a wholesome supply."

8. The lecturer next went on to say that in many parts of Jamaica the soil is so porous, and the underlying rocks of such a kind, that a large share of the rain-water that soaks into the highlands passes away to the sea in deep, underground channels.

9. "In such tracts of country," he continued, "tanks of stone-work and cement are necessary to collect and store the rain-water. In some districts the parishes have established water-works to avoid distress in times of drought.

10. "It is perhaps needless to add that when tanks are used they should be regularly cleaned, as they gradually become coated with matter that would make the water foul."

WATER.—II.

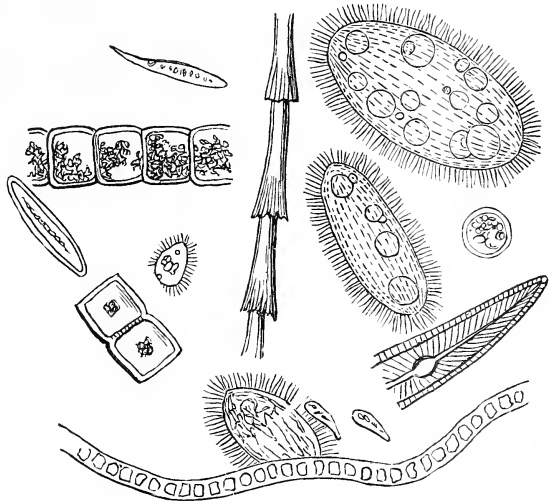
1. The next day, when Miss Brooks and May were talking about the lecture, May said: "Do you remember that the gentleman said, 'Whatever a person's weight may be, about two-thirds of it is the weight of the water in his body?'"

2. "He did;" replied Miss Brooks. "We take water in all our foods, even in those that seem to

be dry, as well as in the fruits whose juices show plainly that water is present. We also take a great quantity of water as drink."

"Do you know what use the water is to our bodies?" asked May.

3. "I can tell you some of its uses," said Miss Brooks. "It softens and dissolves some of our food, and then it acts as a carrier to take the dissolved food into the blood, and the waste matters out of the body. It is, indeed, only in the liquid state that food can really become part of the body. So liquids are even more necessary than solids. A man can live much longer without any solid food, if he has plenty of water, than he can if no water be given to him."

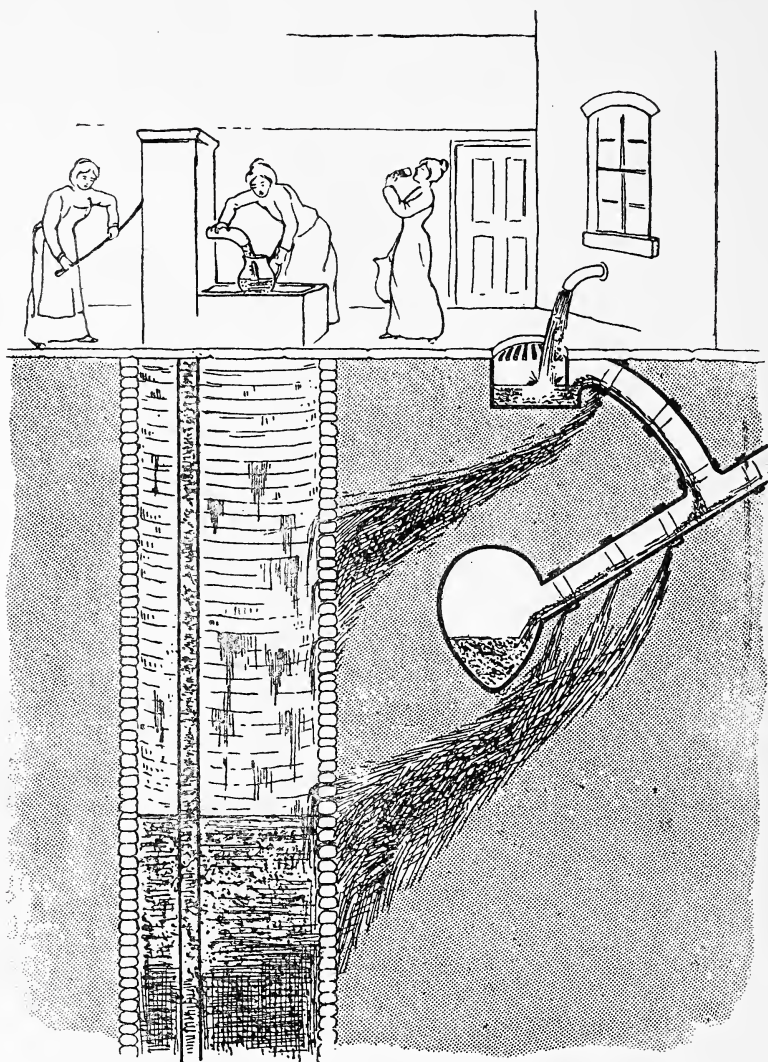


Some Animal and Vegetable Structures found
in a Drop of Impure Water.

4. "But the gentleman warned us not to drink bad water," said May. "He said it might make us ill."

"Yes; he said how dangerous it is to drink water in which the remains of animals or plants are decay-

ing. What is to be most dreaded is water containing sewage or animal refuse, in which there may



How People Drink Sewage: Drain Leaking into a Well.

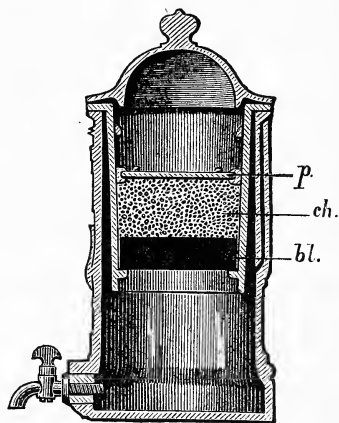
be the germs of certain diseases, such as cholera and typhoid fever.”

5. "How are we to know when the water is not fit to drink?" inquired May.

"We cannot always tell by its appearance," said Miss Brooks; "though very often the vegetable matter will tinge it with colour. Sometimes we may smell that there is something bad in it. A chemist, however, has ways of finding out exactly what the water contains.

6. "But we can do something to guard ourselves against anything that may be harmful in it."

"Oh, I know!" cried May, very pleased to show how much she understood. "That is why you always wish to have the water boiled and filtered before we drink it."



Cleansable Filter.

bl, Block of carbon; *ch*, layer of granulated charcoal; *p*, porous earthenware plate.

7. "Quite right, May! The water which is sent to us from the water-works has been filtered through a bed of sand and small gravel; but you see I take a little extra trouble to filter it again at home. And I have it boiled in the hope of destroying any germs of disease that may be in it.

8. "Perhaps I am more particular than many other people about this; because," added Miss Brooks sadly, "my dear little sister died from an illness brought on by drinking water into which

something bad had leaked, though, until the mischief had been done, we did not know the water was unfit to drink."

9. Presently Miss Brooks said: "It has been proved that cholera and typhoid fever are caused by drinking impure water. It is known, too, that malarial fevers may be brought on by drinking water from marshy lands, as well as by breathing the air that blows over them.

"So it is clearly our duty to do all we can to see that the water we drink is sweet and pure."

OTHER BEVERAGES.

1. "Did I ever tell you the story of the goats and the coffee-trees?" asked Miss Brooks one day.

"No," replied May. "Will you please tell it to me?"

2. "I will," said Miss Brooks. "Once upon a time there was a monk who was unhappy because he could not keep awake at night, when he had duties to perform. One moonlight night, while looking out upon the fields, he saw some goats capering about, and stopping now and then to make their supper from the leaves of a wild coffee-tree growing near his window.

3. "The next night he picked some of the leaves

and fruit of this tree, and made from the berries the first cup of coffee ever tasted by man. The drink seemed to make him almost as lively as the goats had been, and his eyes were not at all sleepy. In this way, it is said, the refreshing effects of coffee were first found out."

4. "Is that a true story?" asked May.

"There is most likely a good deal of 'make up' about it," replied Miss Brooks. "But at least it is true that the favourite beverage made from the coffee seeds does stimulate us, and that we feel strengthened and refreshed by it.

5. "In this respect tea and chocolate resemble coffee, though chocolate is not so stimulating as the other two beverages. It is, however, very nourishing, and contains much fatty food."

"We don't take coffee in the same way as we take chocolate," said May.

6. Miss Brooks asked her to explain what she meant.

"I mean that we drink the water in which the coffee has soaked, and leave the 'grounds'; but we mix the chocolate up in the water, and drink the whole."

7. "That is because we know chocolate to be a good and pleasant food," said Miss Brooks. "It chiefly consists of oil (or cocoa-butter), starch, and gluten; in which, as you know, we have two heat-givers and a flesh-former."

“I wonder what there is in coffee to make us feel refreshed like the monk,” said May.

8. “I will tell you; but I shall have to use some hard names. In the coffee there is a substance called *caffeine*. It is also present in tea under the name of *theine*; and there is something nearly like it in chocolate, known as *theobromine*.

9. “Coffee, chocolate, and tea also contain an oil, which, in each case, gives the odour and taste that we know so well.

“You know that we make very cooling drinks from some of our fruits and water,” continued Miss Brooks.

10. “There is the drink which is made by pouring warm water over tamarinds; and that which is made by adding water to the acid juice of limes and citrons. Again, in the young cocoa-nuts we find a sweet and refreshing drink ready made for use.”

11. You have not said anything about rum,” said May.

“No,” replied Miss Brooks. “It is one of those drinks which contain alcohol, and which you and I can do very well without. Such drinks are quite unnecessary to people who are well and strong, though they are often useful in times of illness.”

WHAT BECOMES OF OUR FOOD.

1. "Here are some pictures for you to see, May," said Miss Brooks. "They

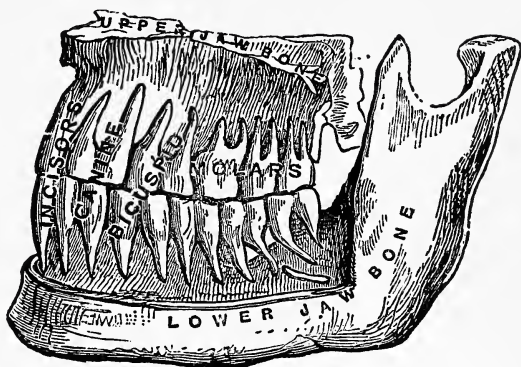
will help you to understand how we digest our food. First, here is a picture of your teeth,

and another of your mouth, with the food-pipe down which the food

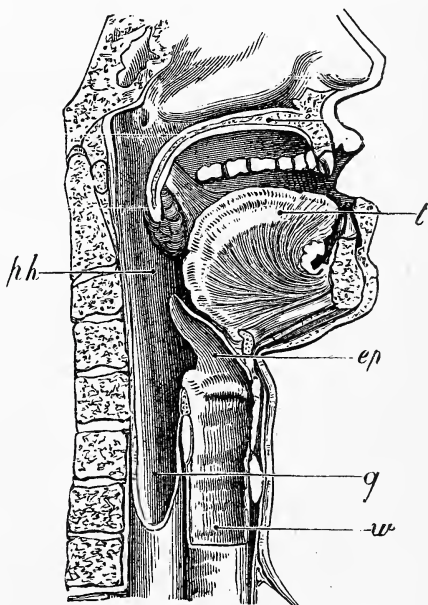
passes to the stomach after it has been moistened and chewed in the mouth.

2. "If you chew some corn or other starch food, you will notice that after a little time it tastes rather sweet. That is because most of the starch has been changed into sugar, by the *saliva* of the mouth mixing with it."

3. "Oh, yes!" said May. "I remember



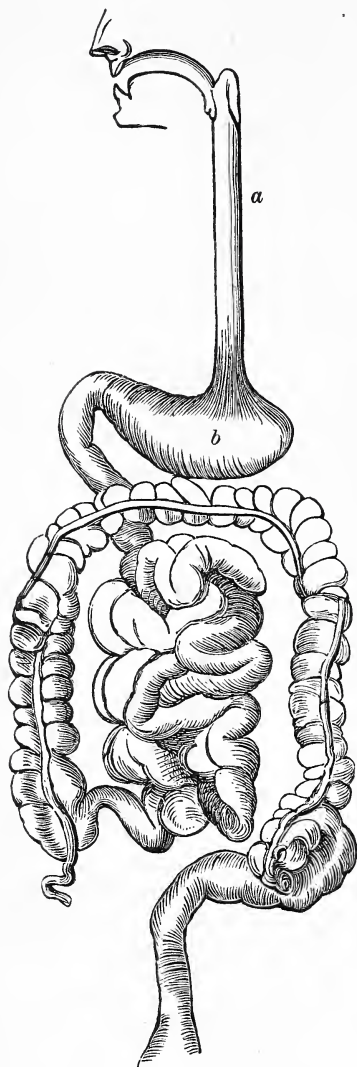
Human Teeth.



Section showing Mouth and Nasal Cavities, Gullet, Windpipe, &c.

t, Tongue; *ph*, pharynx; *ep*, epiglottis; *g*, gullet; *w*, windpipe.

that you told me the starchy part of the food was digested in the mouth, and the flesh-formers in the stomach."



Alimentary Canal, including Gullet (a), Stomach (b), Large and Small Intestines.

4. "I did," continued Miss Brooks. "Here is a picture of the stomach, and the pipes that are connected with it. From the inner side of the stomach thousands of tiny bags pour out a juice—called the *gastric juice*—which mixes with the food and dissolves (or digests) the lean meat and other flesh-formers."

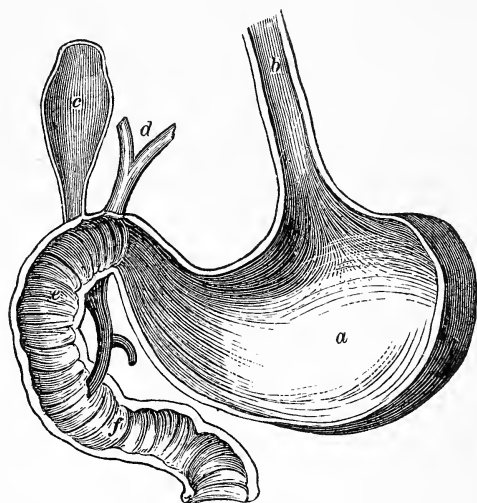
5. "And what happens then?" asked May.

"Much of the food which has been turned into liquid in this way passes, at once, into the little blood-vessels that are abundant in the wall of the stomach. The rest, with the undigested part, passes into the long tube, called the intestines, that leads from the stomach.

6. "But here two other fluids, the *bile* and the *pancreatic juice*, pour in to complete the work of

digestion. The bile runs in through a little tube leading from the liver, where it is made. It causes the fats to break up into the smallest pieces you can imagine, thus changing them into a fluid state.

7. "The pancreatic juice flows from the pancreas or 'sweetbread'. It turns into sugar any starch that escaped the action of the saliva in the mouth. Besides, the pancreatic juice digests any nitrogenous foods that may have passed on from the stomach, and it also breaks up fat as the bile does. In fact the pancreatic juice is the most perfect digestive fluid of the four I have named.



a, Stomach; *b*, Gullet; *c*, Gall-bladder; *d*, Bile-duct; *e*, Pylorus; *f*, Duodenum.

8. "As the food is forced along, the parts that have been digested are taken into the blood-vessels in the walls of the intestines."

"Then our blood gets the flesh-formers and heat-givers in the end," said May.

9. "Yes; but only to give them up again," said Miss Brooks. "Whatever our food may be—solid or liquid; animal, vegetable, or mineral; heat-giving or flesh-forming—it must pass into the blood before

it can nourish the body; and more than that, it must itself become blood.

10. "Some people call our blood 'the life stream'. Like a stream it is always flowing, and it carries to every part of the body the material that is needed for growth and repair, and brings away the waste. In short, the food is changed into blood, which in turn is changed into muscle, bone, and nerve."

THE AIR WE BREATHE.

1. Without food we might live for a few days; but without air we should certainly not live many minutes. It is well, then, for us to know what the air is, and what it contains that is so necessary to our lives.

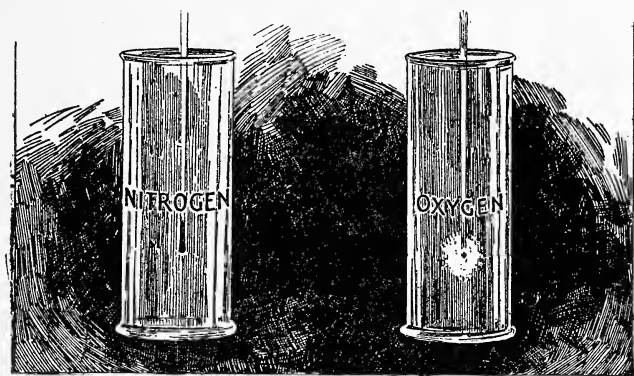
2. The air we breathe surrounds the earth to a height of many miles. It is a mixture of gases, of which the chief are *nitrogen* and *oxygen*. There is also *argon*, a gas which men who study such things have only lately found out; and there are small quantities of *carbonic acid* and other gases. Besides these there is water-gas, or *vapour*.

3. Oxygen is common everywhere. It forms about one-fifth of the air; with hydrogen gas it forms water; and it makes up about half the weight of the earth.

4. It is the oxygen of the air that causes fuel to

burn, and when it passes through our lungs into the blood, it slowly 'burns' or changes the substances that are there. And these changes are so necessary that, if we are unable to keep up a proper supply of oxygen to cause them to take place, we become ill.

5. Nitrogen, like oxygen, cannot be seen, tasted, or smelt. It will neither burn, nor cause other



The Effects of Oxygen and Nitrogen on a Lighted Match.

things to burn. But it is well that the air contains a large proportion of nitrogen, because we could not live long if we breathed pure oxygen. When we breathe we take into our lungs only about one share of oxygen to four of nitrogen.

6. All animals in breathing, all fires in burning, and all refuse in decaying, are continually adding carbonic-acid gas to the air. How is it, then, that there is not much more of this gas in the air than there was ten or a hundred years ago?

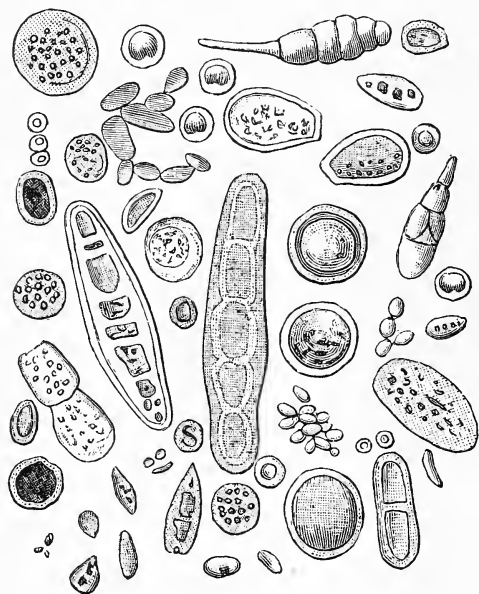
7. We have only to turn to the plants for an

answer. During the time of sunlight they are continually taking in this gas, and separating the carbon and the oxygen of which it is formed. They keep the carbon to build up their leaves, stems, and other parts, and send the oxygen out again. Thus plants and animals between them keep up the

balance of oxygen and carbonic acid in the air.

8. Carbonic-acid gas is very poisonous. If an animal breathes much of it, it dies, although it may have plenty of oxygen.

9. The vapour in the air comes from the various bodies of water on the earth, from the breath of animals, and from the



Solid Impurities in the Atmosphere.

leaves of plants. The quantity that is present at any time depends upon the warmth of the air and the direction of the winds. The warmer the air, the more vapour it can hold.

10. In the higher and cooler regions of the air the vapour gets chilled, and then the moisture forms clouds. When these are still further cooled, by cold currents of air meeting them, the water can be no

longer held, but falls as rain. So, also, when the air is chilled at night by the ground becoming cool, it is robbed of its vapour, and the plants and other things near the ground consequently become covered with moisture, which we call dew.

11. Amongst the impurities in the air, in addition to various gases, there are always numberless specks of solid matter; such as dust, hairs, scales of skin, starch grains, fragments of plants, and disease-germs.

WHY THE WIND BLOWS.

1. Although we cannot see the air we may feel it, if we wave our hand quickly through it. It is always in motion, as we can tell by the waving of the leaves, or by the force of the breeze that blows upon us.

2. This constant movement of the air is one of the reasons why its gases are so thoroughly mixed together; indeed, they are found in very nearly the same proportion everywhere.

3. But what is it that sets the air in motion, and thus causes the winds? To understand this you must know that air expands, or takes up more space when it is heated.

4. If the air in an open bottle be warmed it will expand, so that a little of it must pass out. It is plain that the air that then fills the bottle will

weigh less, or be lighter, than the cold air that filled it. So we must remember that any volume of warm air is lighter than the same volume of cold air.

5. Now let us find out what happens when any portion of the earth's surface has been heated by the sun. The heated part warms the air that lies next to it. This air at once becomes lighter than

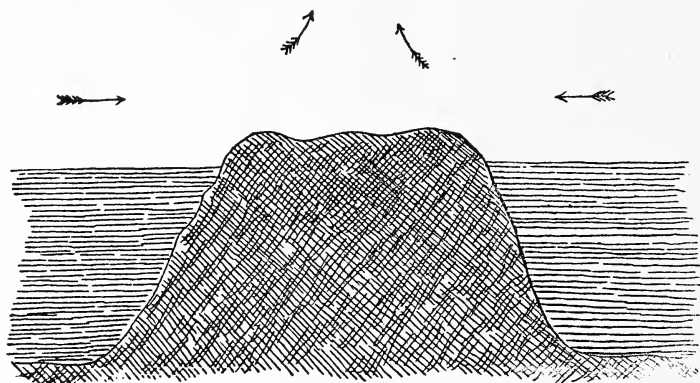


Diagram illustrating Sea-breeze.

it was, and therefore rises higher; while the colder and heavier air that is near rushes in to take its place. In this way a wind is produced.

6. As an instance we may say a few words about the land and sea breezes, which are well known in the islands of tropical seas. And, in learning the cause of these breezes, we must bear in mind that the land always takes in heat or gives it out again more quickly than water does.

7. Therefore, while the sun is shining, the land gets much hotter than the sea. The heated land in turn heats the air that is over it, thus causing it

to expand and to become lighter. Then, of course, the warm air rises. At the same time the cooler and heavier air from over the sea rushes in to take its place, and thus we get a *sea-breeze*.

8. During the night the land gives up its heat more quickly than does the sea, until it becomes the cooler of the two. Then the colder air moves outwards from the land to the sea, taking the place

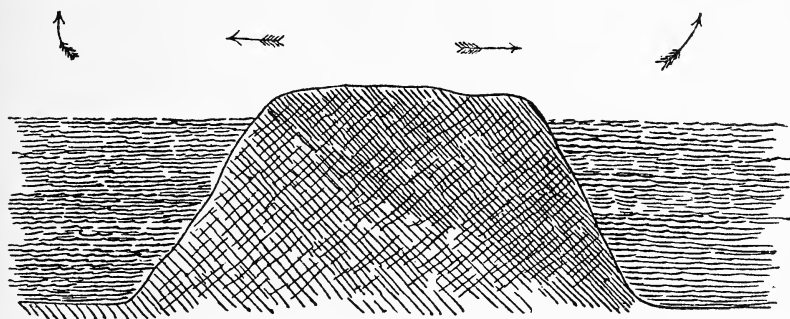


Diagram illustrating Land-breeze.

of the warmer and lighter air that rises over the water. And in that way a *land-breeze* is produced.

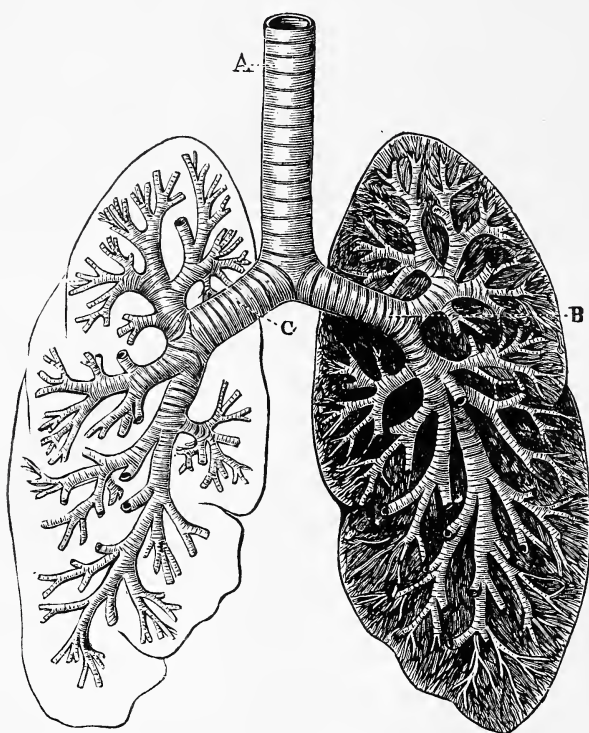
9. Taking the breezes at Kingston as an example, we find that a northerly wind blows there at night from the land; and, as the day advances and the land becomes heated, this gives place to a south or south-east wind from the sea.

VENTILATION.

1. The air that a person breathes out from his lungs is very different from that which he takes

into them. It has much less oxygen, and more carbonic acid; it is also warmer, and contains waste matter, which the body, by its means, casts out.

2. It is this waste matter, even more than the carbonic-acid gas, that makes it so unhealthy to



Section showing the ramifications of the Bronchi in the Lungs. A, Windpipe or trachea. B, Bronchi. C, Bronchial tubes.

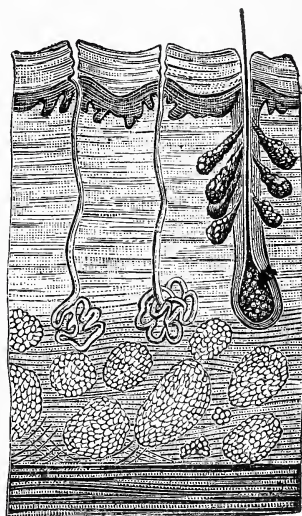
breathe the air of a room over and over again. It is the cause of the nasty stuffy smell in rooms where people remain without letting in fresh air.

3. Through the pores of the skin, as well as by the breath, the body never ceases to pass impurities into the air. Therefore, we cannot have the air

in our houses quite as good for breathing as the air outside; yet we can do much to keep it from becoming harmful to us.

4. We can cause currents of air to pass through the room, that they may not only carry away or drive out the used-up and impure air, but may bring pure air to take its place.

5. This is what is meant by ventilation. It is the means by which the air in and beneath our dwellings is made to move on. But it cannot do this unless there is a sufficient outlet for the foul air and an inlet for the fresh air. In warm countries the doors and windows serve these purposes in the day-time, but there ought to be other openings for use when doors have to be closed.



Structure of the Skin

6. Of course we should take care what sort of air we let into the house. An exchange of one bad servant for another equally bad would leave us no better for the exchange. We ought to see that we get a supply of the driest and purest air that is to be had, and that it does not come in as a chilling draught.

7. It is chiefly at night, when our rooms are closed, that the air in them becomes foul. There-

fore, when there is no danger of malarial air entering from outside, the windows of the sleeping rooms should not be closed, unless the rooms are ventilated in some other way.

8. Sleeping in rooms where the air is allowed to become foul and unhealthy causes us to rise in the morning with headache, or with a feeling of dulness and weariness, and may even bring on serious illness. Of course, the windows should not be kept open at night where the wind blows chiefly from malarial places.

9. When, from any cause, a house shows signs of dampness in its walls or floorings, there is more need than ever for plenty of ventilation, because the moisture rising from the soil brings with it gases that are dangerous to health. Every ground-floor should therefore be raised above the soil, and air should pass freely through the space beneath it.

THE CLOTHES WE WEAR.

1. Before describing what are the best materials for clothing, it is well to say a few words about the heat of the body.

2. A doctor often places the bulb of a small thermometer in the mouth of a person who is ailing, to find out whether the body is at its proper temperature. He knows that it ought to have an

amount of warmth which will be marked on his thermometer at about 98 degrees.

3. No matter what the state of the air around us may be, the warmth of the body does not alter, if we are in health. This is the case whether we are in the icy regions of Greenland, or the hot lands of the tropics. It remains unchanged if we begin the



A Doctor's Thermometer.

day in the scorching plains of our island, and end it in the coldest parts of the highest mountains.

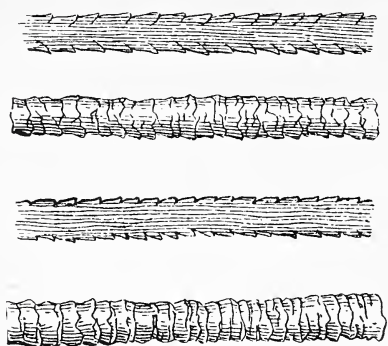
4. It is by the slow burning of the food which we eat that this heat is produced within our bodies. At the same time heat passes away from the body by the breath and the skin; so that a loss as well as a gain is always going on, the one balancing the other. That is how it is that the warmth of the body remains unchanged.

5. We may greatly aid the body in preserving its proper balance of heat by wearing clothing. In a hot country our clothes shield us from the burning rays of the sun; and where the climate is cold, they prevent the heat of the body being carried away too fast by the cold air.

6. This, however, is not the only use that clothing is to us. It also protects the body from dirt, and saves the skin from many a small injury.

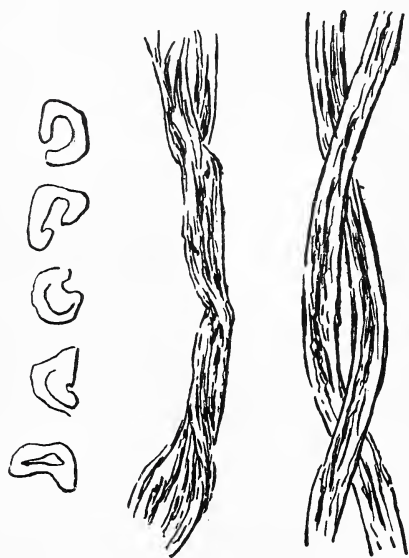
7. Through some kinds of clothing the heat passes

much more quickly than through others, so that, in making our choice of material, we must be guided by the climate in which we live. Thus, the natives of Greenland or Lapland clothe themselves in thick furs or heavy woollen clothing, while the people of hot lands mostly wear thin garments of cotton.



Fibres of Wool as seen under
Microscope.

8. We should take care to have our clothing loose or porous, that the vapour from the sweat of the



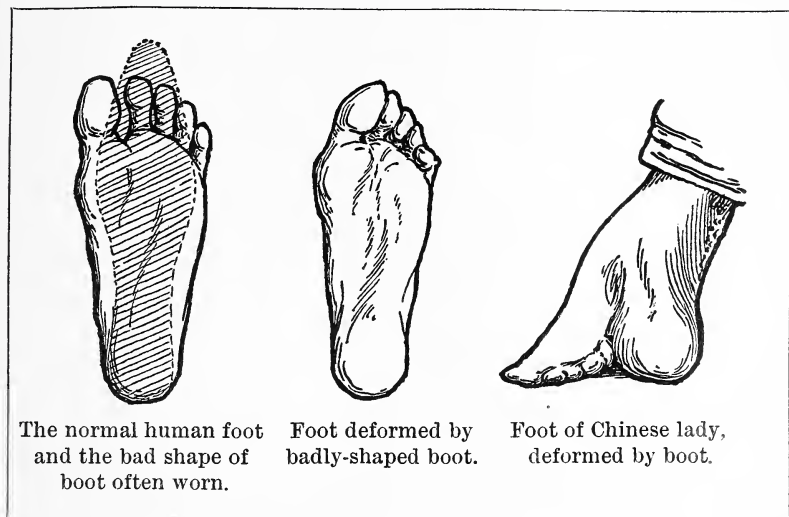
Section of Cotton Fibre and whole Fibres
under the Microscope.

body may be able to pass away through it. For this purpose loose woollen clothes are the best, especially if they are worn next to the skin. The wool not only sucks up the moisture, but, where the air is cool, it prevents the sweat drying up so quickly as to chill the skin.

9. In hot countries cotton clothing is very commonly worn, because it is light and thin. It is also cheaper than wool, though it does not take up the

moisture from the body so well. Calico, 'print', and other cotton material for clothing are made from the masses of long, white hairs surrounding the seeds of the cotton plant.

10. Linen is made from the fibres of the flax plant. It soon becomes soaked by perspiration if



worn next the skin, and is less useful than cotton or wool for clothing.

Silk, another useful article of clothing, is made from the cocoon of the silk-worm. This material is not commonly worn, because it is expensive.

11. To protect the feet from wet and from injury by sharp stones there is nothing better than leather, which is made from the hides of animals. If boots are worn they should not be tight; if they are, the strong leather cramps the feet, so that they cannot grow to their proper shape. This is well seen in

the picture. There you see the shape that the foot ought to be, and also the shape to which it may be brought by the pressure of tight boots.

12. In wet weather some persons wisely wear a 'water-proof' coat of india-rubber or of thick wool, to keep their clothes dry. It is not possible for all of us to do this; but if the clothing next our skin become wet with the rain, we ought to change it, for it is very dangerous to health to wear wet clothes while they are drying.

13. As to the colour of clothing, in a country where the sun's rays are very powerful the best is white or light gray. This is because light-coloured materials do not absorb the sun's heat as readily as those that are black or dark-coloured.

SOIL AND CLIMATE; OR. WHERE TO LIVE.—I.

1. In considering what sort of climate any place has, we must take into account the warmth and moisture of the air, the direction of the winds, and the amount of rain that falls.

2. The West Indies, being in the torrid zone—the hottest region of the earth—have a very warm climate. But, as the height above the sea-level, as well as the distance from the equator, has much to do with the temperature, a ride of a few miles up

the hills will take us into a different climate from that of the plains.

3. As we ascend the mountains we find that the air gets about one degree cooler for every 300 feet above the sea. Thus, at Kingston, which is not far above the level of the sea, the average warmth of the air is 79 degrees; while 5000 feet up on the mountains, in the Hill Garden of Jamaica, it is only 63 degrees.

4. There is even a greater difference between the amount of rain at these two places—more than three times as much falling at Hill Garden as at Kingston. This is because the trade-winds, before reaching the city, are drained of much of their moisture by the mountains lying to the north and east.

5. These facts show that the climate is not the same in all parts, even in a small country like Jamaica.

If we were quite free to choose where to live, no doubt we should make it our first care to choose a spot where the soil and climate were not likely to be harmful to our health.

6. In the first place, the drier the soil the better it would be as a site for our dwelling. Sand, chalk, limestone, and gravel let the water pass freely through them; but soils that are clayey hold it and become soaked.

7. By digging we may find water soaking the soil only two or three feet below the surface, or in other

places it may be very far down. But the nearer it is, the damper and more unhealthy becomes the top-soil, because the water rises through it.

8. As a rule, the soil that has least dampness is a gravelly one, if it does not receive the drainage from higher land.

9. Peaty soils, and those that have been formed by the mud brought down by rivers, are usually very damp. In them there is much decaying animal and vegetable matter, which gives off gases that are bad for us. It is in the early morning, or towards evening, that the poisonous vapours from such soils are most to be feared. The sun causes them to rise towards the sky by day; but in the cold of night or morning they float around us, and are likely to bring on illness.

10. In some countries the subsoil is drained, where needful, by laying in pipes to carry off some of the water. This is a very good plan; and, if it were carried out in Jamaica, most likely there would be fewer cases of fever.

11. We must bear in mind that, when the water in the subsoil rises, the gases that are in the soil above it are forced out. From this cause a site may be unhealthy even where the top-soil is mostly dry. In fact, some of the gravelly banks of the Jamaica rivers are known to be malarious.

SOIL AND CLIMATE; OR, WHERE
TO LIVE.—II.

1. It is well to have our houses built in an airy position on the slope of a hill. On the hills the air is cooler, purer, and more bracing than in the low-lying districts, and it therefore makes us feel bright and active. We should, if possible, avoid the ravines, because there decaying vegetation often collects, and at night cold currents of air sweep down from the hills. In Jamaica, we do not find that malarial ailments trouble the people who live on the mountains above the height of about two thousand feet; unless, indeed, coffee pulp or other refuse be left to rot in heaps next their houses.

2. If a country be near the sea, the warmth of its air is much more steady and regular than it would otherwise be. This is because the water cannot be so quickly heated as the land, nor does it give up its heat so rapidly. So we find that the air of Jamaica does not have great and sudden changes of temperature, such as are felt in places on the mainland of America, at the same distance from the equator.

3. In our island, whether we live in a warm or a cool district, the warmth of the air about us does not vary greatly from time to time. And this is of great advantage to us, because sudden changes are not good for health.

4. If we wish to avoid a district where much rain falls, we must consider the direction of the winds.

The trade-winds bring with them a large quantity of moisture, which they gathered up as they swept over the ocean. When they become chilled by the highlands they can no longer hold their moisture, which therefore falls in plentiful showers.

5. From this cause the north-east part of Jamaica—the part facing the rain-bearing winds of winter—has a large rainfall in November and December. On the other hand, in the south there are summer rains in August and September.

6. We are well aware that air which is not kept moving becomes unhealthy, and that houses are not likely to be free from dampness if the air cannot pass thoroughly into them. Therefore, wherever our house may stand, it should not be surrounded closely by bush, for this would prevent the air from blowing freely round about it. It is, however, a good thing to have a few tall trees to give shade, though these should not overhang the house.

7. Where plants and trees grow thickly over large areas they make a great difference in the dampness of a climate. They screen the soil from the rays of the sun, so that the air above it becomes cooled, and consequently sends down rain. They also suck up much moisture from the soil, and give it off to the air through their leaves.

8. Enough has been said to show that there are

many circumstances to consider in choosing a suitable site for our dwelling. By attention to them we may live in fresh air and healthy houses; and these are as needful to us as good food and pure water, if we would enjoy the greatest of all blessings—good health.

PART V.—GOVERNMENT.

WHY LAWS ARE MADE.

1. It is nearly two and a half centuries since the English took Jamaica from the Spaniards, the latter having occupied it since its discovery by Columbus in 1494.

2. At that time Oliver Cromwell was the chief ruler in England, and he sent an officer out to the new colony with orders to prepare the way for its proper government. Thus it was that the welfare of our island-home came to be linked with the fortunes of Great Britain, and to-day Jamaica is a part of a world-wide empire, whose people enjoy the blessings of freedom and good government.

3. In this empire, which spreads through every variety of climate, and is inhabited by peoples of almost every race, we have many different governments. But all the people in the empire are subjects of the same sovereign, and as a sign they all use the same flag—the well-known Union Jack, although each country has, besides, a flag of its own. If we love our little island-home, we shall do our best to help to make it one of the happiest

and most prosperous places in the empire to which it belongs. Now this it can never be unless good laws are made and wisely kept.

4. Just think how happy a home is where good order and careful behaviour prevail in the family. In such a home there are rules or little laws, under which the members of the family avoid doing things that would cause distress amongst themselves, and seek to act in ways that will be helpful to one another. Just in the same way there is need for rules and laws amongst men of the same country. Each one shares in the benefits which result from order and good government, for under such conditions he dwells in peace, and his goods are in safety.

5. Have you ever thought how the people are governed in this little island of ours? Who makes the laws for us? who sees that they are obeyed? What is the link that binds us to the mother country of Great Britain?

6. It is well to be able to answer these questions; for the day will come, if you grow to manhood, that you will be called upon to take your share in the work of governing. Certainly it will always be your duty to follow out the laws; and you will be likely to do this the more readily when you understand how carefully they are drawn up, and how large a share the people themselves have in settling the rules under which they live.

THE LEGISLATIVE COUNCIL OF JAMAICA.

1. In the two and a half centuries during which Jamaica has been a part of the British Empire, there have been four forms of government in the island.

2. For the first few years the people were under military rule; then for 200 years men were elected to form an 'Assembly' to carry on the government. Owing, however, to a serious revolt which broke out in 1865, another system was set up. In the following year the island was put under 'Crown government', and the men who formed the Council, or governing body, were all appointed by the Queen, the people having no voice in the matter. But this plan did not last many years. In 1884 it was deemed right that the people should have a share in their own government, and consequently the system under which we are now ruled came into force.

3. Now there are many thousands of men in Jamaica. How can it be possible for so many to take a part in making the laws under which they are to live? The plan by which they can do this is very simple. They choose a few men whom they can trust to conduct the business on their behalf.

4. Every man over twenty-one years of age has a right to take part in the choosing, if only he is a British subject, and pays poor-rates or taxes on a

certain sum, or receives a salary of not less than fifty pounds a year. He is called a voter, because he can vote for the one whom he prefers to have on the Council.

5. Each parish, by its voters, elects one man to represent it, that is, to speak on its behalf in the Council. Thus we now get fourteen elected members of the Council; but until 1895 the number was only nine.

There are also 'official' members of the Council; that is, gentlemen who hold high offices under the government, or who are approved by the Queen on the recommendation of the Governor.

6. In this way the 'Legislative Council of Jamaica' is formed to last for five years; at the end of that time another election of the Council must be made. At any time, however, the Governor has the power to order the work of the Council to cease, and a fresh Council to be elected.

7. Every year, usually in the month of February, the Legislative Council meets at Head Quarter House, in Kingston, to make laws, or to carry on necessary work concerning the government of the colony. The 'session', or time during which the Council meets, generally lasts for about two months; but the members are called together at any other time, if it seems advisable to consider any important question without delay.

8 You see, then, that the law does not depend

upon the power or the force of a few persons, but upon the will of the greater number of the people. As they help to make it, they of course strive to obey it. Almost all the rest obey the law because they know it is wise and right to agree to what most of their countrymen wish. They may, of course, in an orderly and proper way, take steps to get the law changed. But while it stands they know it is their duty to submit to it.

9. And if any men are foolish or wicked enough to refuse to be bound by the law, they soon find that it is stronger than they are, and that it provides for their punishment.

THE GOVERNOR.

1. The 'Captain-General and Governor-in-Chief of Jamaica' is at the head of the government in the island. He stands in the place of His Majesty King George, and is appointed to his high office for six years.

2. Any new laws which the Council wishes to set in force must be agreed to by the Governor. They must also be laid before the Secretary of State for the Colonies, who is one of the chief ministers of the King, and who advises His Majesty whether to allow or to veto them.

3. The Secretary of State is at the head of every-

thing that concerns the management of the colonies of the British Empire. The Colonial Office in



Queen Victoria. (From a photograph by Messrs. Bassano, London.)

London, where all the business of the colonies is attended to, is a very fine building, not far from the Houses of Parliament.

4. That the Governor of Jamaica may be able to seek advice in carrying on the government, he has a 'Privy Council'. This is a small council, formed of three gentlemen holding high office in the colony, and three others whose presence at the council the King approves. The three high officials are the Chief Military Officer, the Colonial Secretary, and the Attorney-General.

5. The Privy Council carries out its duties privately, and does not discuss affairs openly, as the Legislative (or Law-making) Council does.

The Governor is provided with an official residence, known as King's House, which stands amongst groups of fine trees on the Liguanea Plain, about 4 miles from Kingston.

6. The ground round about the house is very prettily laid out for the growth of trees and flowers, and there is a beautiful fernery, in which some splendid tree-ferns grow. The gardens are kept in order by the Department of Public Gardens and Plantations.

7. It is at King's House that guests who are honoured by an invitation from the Governor are received by His Excellency. The flag flying at the head of the tall flagstaff in the grounds is the well-known signal that the Governor is at home.

GOVERNMENT IN THE PARISHES.

1. Jamaica is divided into fourteen districts, called parishes; and that the people of each parish may look after their own needs, the Legislative Council has made laws, under which each parish manages certain matters affecting itself alone as it thinks well.

2. If, however, the parish neglects to properly rule over the affairs with which it is trusted, the Governor may interfere and see that the duties are carried out. Through its voters each parish chooses from fifteen to eighteen gentlemen to form a 'Board'.

3. This name is often given to a number of men who act together in the management of any business. In this case, as the 'Board' is formed to conduct parish affairs, it is known as a 'Parochial Board'. In Kingston, which has many more people than any other town in the island, the Board is styled 'the Mayor and Council of Kingston', the member elected as chairman having the honourable title of 'Mayor'.

4. Kingston is very much smaller than any other parish, being only a little over 7 square miles in size, while the other thirteen parishes extend over very nearly 4200 square miles. St. Elizabeth is the largest, with 471 square miles, though Clarendon, St. Catherine, and St. Ann are each very little less in size.

5. A Parochial Board is elected for three years, and the Governor has the power to dissolve it at any time for gross neglect of duty.

And what is the business which it undertakes?

6. A very important part of its duty is the care of the roads in the parish. There are many very good main roads in Jamaica, which were made and are kept up by the Public Works Department, the cost being paid from the general taxes of the colony. But all the rest of the roads are under the charge of the Parochial Boards.

7. Then there are the poor and infirm people to be cared for; the houses and streets must be kept in a healthy state; markets for the convenience of sellers and buyers must be set up; and, wherever possible, a good supply of water should be provided. These are some of the useful matters which a parish board is able to manage. Of course it takes a large sum of money to carry on such work, and this is paid by the people of the parish, after the Board has agreed upon a 'rate' to fix each person's share.

PUBLIC DEPARTMENTS AND OFFICES.—I.

1. The making of laws is but a small part of the duties of a government. There is very much work to be done in carrying out the laws that have been

made, and in seeing that those who refuse to obey them are justly punished.

The laws have to do with so many different affairs, that it is impossible for one person to manage the various kinds of government business.

2. You know that the owner of large plantations,



Houses of Parliament, London.—View from the Thames.

or any man who has a factory, arranges that each man employed by him shall do a particular part of the work. In the same way the duties of the government are divided amongst several persons, one of whom is placed at the head of each branch or department.

3. It is clear that the business can only be done by sharing it out in that way, when we consider what has to be undertaken. The roads and bridges, the taxes, the courts of law, the police, the schools, and the post-offices, are some of the many important affairs that the government has to manage.

4. At the head of the Departments we have one under the charge of the *Colonial Secretary*, who is the first officer of the government, after his Excellency. It is through his office that letters pass to and from the Secretary of State in London, and in it all the money matters of the colony are arranged.

5. The main roads and bridges, the public buildings, and the lighthouses are under the care of the *Public Works Department*, whose chief officer is called the Director. This department has to see to the repair of about 2000 miles of main roads, as well as of numerous bridges. It has done much to add to the safety and convenience of travelling in the island, by building several fine and costly bridges.

6. Over the Dry River, where the water has been known to rise as high as 37 feet above the bed within a few hours, and at a spot which was dangerous and a hindrance to traffic, a fine bridge, 46 feet above the river bed, has been built, so that, even when the water is at its highest, the river may be crossed.

The Rio Grande Bridge, in the parish of Portland, is the largest bridge in the island, being 520 feet long. It was finished in the year 1892.

7. The *Treasury Department* pays out all sums of money from the government to its officers, or to other people to whom any payment is due. It also manages a number of Savings-banks, for the purpose of helping the people to become thrifty. If a man can save but one shilling he may take it to the bank, and thus start a fund to which he may add whenever he is able. In this way he has an opportunity to put by a portion of what he earns; and thus he may provide enough to establish himself in business, or to be of service to him in the days of sickness or old age.

PUBLIC DEPARTMENTS AND OFFICES.—II.

1. Another department of the government concerns itself with our *Postal* business. For many years the post-office work had been carried on by the Postmaster-general of Britain; but in August, 1860, the duties were handed over to the colony. At that time the cost of sending a letter from one part of the island to another varied from 4*d.* to 8*d.*, according to the distance it had to go. Now we are able to send a letter to any part of Jamaica for a penny. This is one of the many great im-

provements which have been made since the postal service has been managed in the colony.

2. There is a *Medical Department* to look after matters of health, and the island is divided into a great number of districts, each of which is under the charge of a medical man. At the head of the Department is the Superintending Medical Officer, whose duty it is to see that proper attention is given to the sick poor, and to the people in hospitals, almshouses, and prisons.

3. The *Board of Education*, with the Superintending Inspector of Schools at its head, is charged with the duty of seeing that every boy and girl in the island has an opportunity of receiving the benefit of a good schooling. Every year the government grants large sums of money for the support of the schools. The training and the knowledge gained in them will help young people to become sensible and useful men and women.

4. One great department, the largest of all, undertakes the collection of the money needed for carrying on the government of the colony. This money is raised chiefly by rates, taxes, and customs. But it would be impossible for every person to hand in his share of the payment to each separate department. So the government has a '*Revenue*' Department, which arranges to collect all the money. For this work it has an officer,

called the Collector of Taxes, in the principal town of each parish. The money is afterwards divided amongst the different branches of the government, according to the amount that each requires.

5. In addition to the work already described, it is necessary to provide for the trial and punishment of those who disobey the law.

About this great department of government, and about the public gardens and plantations which have done so much for agriculture in the island, more shall be said in the chapters that follow.

THE COURTS OF JUSTICE.

1. It would be of little use to have a Legislative Council for making laws, and well-managed departments for carrying them out, if we did not also have some means of settling disputes, and of punishing those persons who will not obey the law.

We therefore appoint men, who are well trained in the knowledge of the laws, to be judges and magistrates; and they hold courts, where offences against the law and disputes between people are considered and dealt with.

2. Men of high character are chosen in every parish to be 'Justices of the Peace', and power is given to them to hear and decide some of the cases in which people are charged with breaking

the law. Their courts are known as 'Petty Sessions Courts'.

3. Each parish has a Resident Magistrate, who undertakes the trial of cases that the Justices of the Peace have not authority to hear. He takes a part in the trials at the Petty Sessions, acting as Chairman of the Justices when he is present. His own court, at which he alone has authority, has the power in certain cases to lay a fine of £50 upon an offender, or, for very serious offences, to send him to prison for twelve months.

4. It is also the duty of the Resident Magistrate to act as Coroner for his parish; that is, to hold a court of inquiry in all cases in which a person dies suddenly, or from causes that are not well known to be natural and satisfactory.

5. Great care is taken that no man shall be treated unjustly. If anyone thinks that his case has been decided unfairly in the Resident Magistrate's Court, he has a right to go to the Supreme Court, which is the highest of all, to have his complaint heard by the Judges.

There are three Judges appointed to form the Supreme Court, one of whom is styled the 'Chief Justice of Jamaica'. This court is held at Kingston at least six times a year.

6. For the trial of the greater crimes—such as murder, arson, horse and cattle stealing, &c.—one of the judges holds a court in the principal town of

each parish three times a year. Because the judges travel round the country from one town to another for this purpose, their courts are called 'Circuit Courts'.

7. Every case of crime tried by a judge in the Circuit Court is heard before a jury. That is, a number of men are called together to the court, to listen to the evidence on both sides, and the judge makes plain to them what the question is that they have to decide. Then they declare whether they consider the accused person 'guilty' or 'not guilty'. If they say he is guilty, the judge passes sentence of punishment upon him.

8. Under such a method, every man must feel that he has a fair trial. His conduct is judged, not by one person only, but by a jury, or company, of his own countrymen; and in cases of crime their decision is final, and cannot be appealed against to any other court.

PUBLIC GARDENS AND PLANTATIONS.

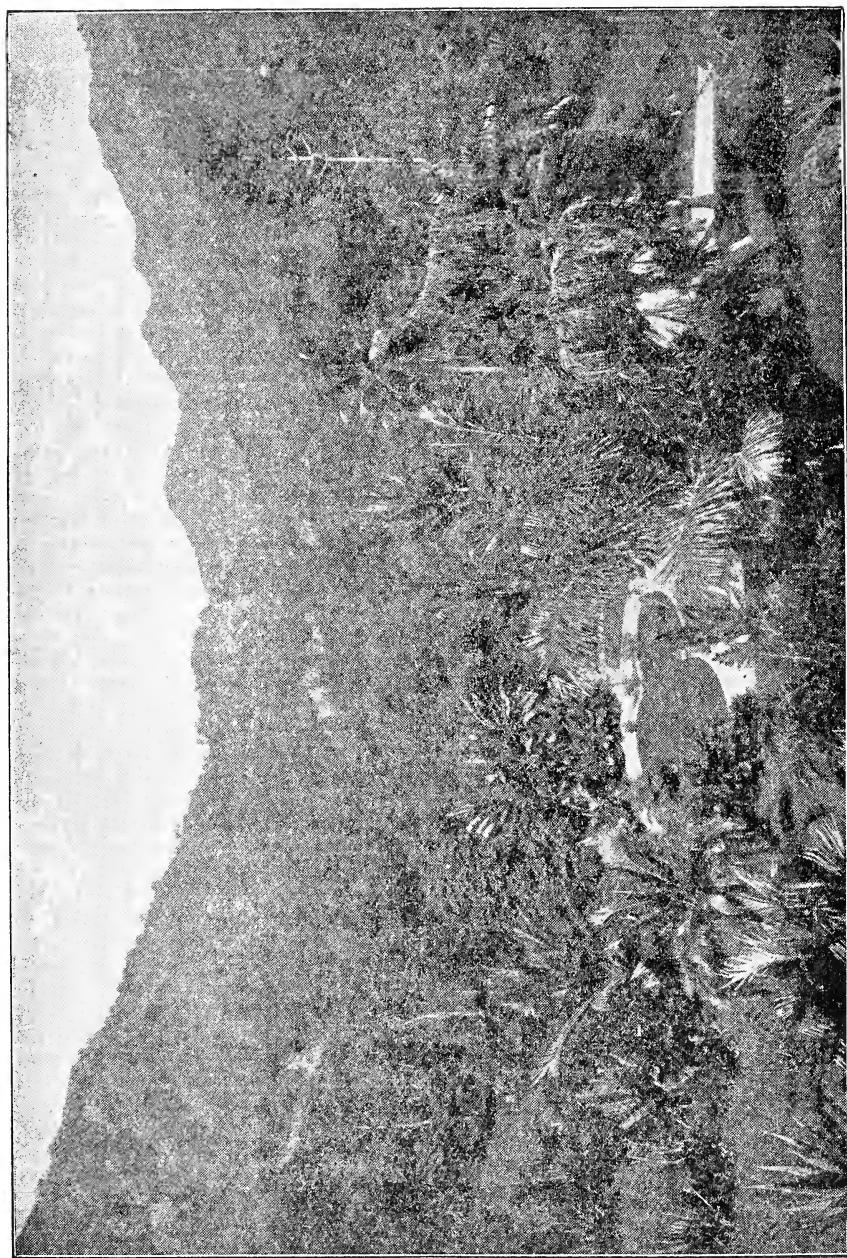
1. Let us in fancy stand near the ships that are being laden in either of our ports; and notice the goods Jamaica is sending off to other countries. For it is upon the sale of these that the prosperity of the island chiefly depends. If we can sell plenty of our own produce, we get money with which to buy other things that we need.

2. There, on the busy wharfs, we may see hogs-heads of sugar and casks of rum, bales of tobacco, bags of coffee or pimento, bunches of bananas, and boxes or barrels of oranges, cocoa-nuts, and other fruits. It is plain, then, that the articles which Jamaica supplies to other countries come from the trees and plants, or are prepared from their products. Therefore it is very important that we should understand how to make the best use of our land, that our produce may be both good and abundant.

3. The government endeavours to encourage and assist the agricultural work in the island, and for this purpose there is a Department of Public Gardens and Plantations.

4. This Department seeks to introduce and rear any useful plants that may be likely to thrive in our soil and climate, and to make known the best way to cultivate them. It also informs us how to deal with diseases, or with insect pests, that do harm to our plants. And it tries to find out what fibres, fruits, juices, woods, or other parts of plants may be of service to us for clothing, food, dyes, medicine, &c.

5. During the last hundred years many of the valuable plants from which we get our chief products have been reared in the public gardens, and then sent out to the planters. Indeed, with the exception of pimento, almost all the plants that we now value most have been introduced from other



Castleton Gardens, Jamaica. (From a photograph by Valentine & Sons, Dundee, Scotland.)

parts of the world, and many of them grew for the first time in Jamaica in the government gardens.

6. The oldest of the public gardens in the island is the Botanic Garden at Bath; and, though now much smaller than it was at first, it is still kept up for the sake of its fine trees and palms.

Amongst the many useful plants which this garden has established in Jamaica is the cinchona, whose bark yields the valuable medicine known as quinine. It turned out, however, that the cinchona plant would not flourish well in the hot climate of Bath, and that it needed a mountain climate, with abundance of rain.

7. A piece of land was therefore obtained in the parish of St. Andrew, on the slopes of the Blue Mountains, its highest part being over 6000 feet above the sea. This is called the Hill Garden and Government Cinchona Plantation. It is 150 acres in size, and almost all of it is planted with cinchona.

8. Nearly 20 miles from Kingston, on the road to Annotto Bay, and in the parish of St. Mary, is the Castleton Garden, well filled with tropical plants. Here many grand palms may be seen, as well as a fine collection of spice and fruit-trees.

9. The Hope Garden is near the foot of the hills, on the Liguanea Plain, and 5 miles from Kingston. It is 200 acres in size, and may be considered the chief garden of the island. In one part of it carriage-drives have been made to the length of 2

miles, and there are nurseries with thousands of young plants, such as cocoa, coffee, rubber, spice, sarsaparilla, and many others.

10. Kingston Parade Garden is the public pleasure-garden of Kingston, and it is made lovely with rare trees, flowering-plants, and fountains.

Around the residence of the Governor are the King's House Gardens and grounds, in which many fine palms and other plants may be seen.

11. We find, then, that the Department of Public Gardens and Plantations does something more than help forward the agriculture of the country. It also beautifies and maintains in order places which people may visit with great enjoyment, and in which they are able to learn something about the wonders of the vegetable kingdom.

12. One other plantation has to be mentioned to make the list complete. It covers the narrow bank of sand, 5 miles long, which incloses Kingston Harbour, and is known as the Palisadoes. On it about 23,000 cocoa-nut palms are growing.

ARMY, NAVY, AND VOLUNTEERS.

1. Any man may be proud to wear the scarlet jacket, white turban, and loose breeches, which form the dress of a soldier of the West India Regiment. The history of what this gallant regiment

has done tells of deeds of bravery and of duties well performed.

2. Since these black troops, commanded by British officers, were first formed, more than a hundred



Gun Detachment, W. I. Regiment. (From a photograph by Valentine & Sons, Dundee, Scotland.)

years ago, they have taken part in battles in Africa, in America, in the West Indies, and in other countries. Many are the hardships they have borne with courage and patience; many are the high praises they have received for their services to the Empire.

3. One battalion of the regiment is always stationed in Jamaica, at Up Park Camp, a little way out of Kingston. There the men have comfortable barracks, in a situation open to the healthy sea-breezes. Meanwhile, the other battalion is on duty on the West Coast of Africa.

4. At Newcastle, in a healthy spot 4000 feet up on the steep slopes of the Blue Mountains, the white troops stationed in Jamaica have their camp.

Altogether there are mostly about 1500 soldiers in the colony—a small part of the army that stands ready to fight, if need be, in defence of King and country. Let us hope, however, that the day is far distant when they will be called upon to do duty on the battle-field; for a country is happiest when at peace.

5. Usually a large ship-of-war may be seen lying off Port Royal, or cruising not far away. At her mast-head flies the long white pennant that marks the ships of the British Navy. She belongs to the squadron which the British government sends to the shores of North America and the West Indies, and which makes Halifax, in Nova Scotia, its headquarters.

6. In the winter and spring of every year the war-ships make a cruise together through the West Indian Seas, calling at the different islands. At Jamaica they usually stay for a week, and it is a fine sight to see the powerful vessels. How different

they are from the ships with which Penn wrested the islands from the Spaniards, or in which Benbow received his death-wound when he fought the French, about two hundred years ago! How different from those which took part in the great battle when the French Admiral De Grasse was beaten, and our colony was saved by the gallant Rodney, whose statue is set up at Spanish Town, the old capital of the island.

7. Far more powerful are the war-ships of to-day; and the men they carry are as brave and as ready for duty as were those of former times.

The British navy is the largest and strongest in the world. When we see the war-vessel at Port Royal, and think of the vast navy to which it belongs, we are reminded of the world-wide empire of which our colony is a part.

8. In Kingston there are over three hundred men who, belonging neither to the regular army nor to the navy, come forward to be drilled at certain times, that they may be ready to stand up, if needed, for the safety of the island. In the country parishes, also, two or three similar companies have been formed.

9. At present all militiamen, as they are called, have joined the military force as volunteers; that is, of their own free will. But should the occasion arise, the Governor has power to call upon men to join the militia. In this way a force of several

thousand could easily be raised for the defence of our island, and for the honour of the Empire to which we are proud to belong.

SUMMARY.

PART I.—ANIMAL LIFE.

THE ANIMAL KINGDOM (pp. 9-52).

Sub-kingdoms.—The Animal Kingdom consists of two great divisions, viz.:—

1. **Vertebrata**; including all backboned animals, and forming a *sub-kingdom*.

2. **Invertebrata**; including all animals without backbones. These animals are arranged in *sub-kingdoms*, thus:—

- (1) Oysters, snails, cuttle-fishes, &c.
- (2) Worms, crabs, spiders, centipedes, insects, &c.
- (3) Star-fishes, sea-urchins, &c.
- (4) Jelly-fishes, sea-anemones, &c.
- (5) Sponges, &c.

Classes and Orders.—Each sub-kingdom is divided into *classes*, and each class into *orders*. The classes of Backboned Animals (sub-kingdom *Vertebrata*) are five in number, viz.:—

- | | | | | |
|-------------|--|----------------|--|------------|
| 1. Mammals. | | 3. Reptiles. | | 5. Fishes. |
| 2. Birds. | | 4. Amphibians. | | |

VERTEBRATA, CLASS I.—MAMMALS (pp. 15-25).

Habitat:

1. The **air**; *e.g.* bats.
2. The **water**; *e.g.* whale, manatee, seal.
3. The **land**; *e.g.* quadrupeds and monkeys.

Characteristics:

1. The **highest** class of the *Vertebrata* in order of development.
2. The **covering**, at some period, and on some part of the body, is always *hair* (wool or fur).
3. The **female** is provided with *milk* to feed her young.
4. The **head** is *doubly-jointed* to the backbone.
5. The **heart** is *four-chambered*; the **blood** *warm*.
6. The **chest** (thorax) and **belly** (abdomen) are separated by a *diaphragm*.

7. **Breathing** is effected by *lungs* (two) in the thorax.
8. The **thorax** is bounded by *ribs*.
9. The regular number of **limbs** is four: legs, or legs and arms.
10. Most Mammals have **teeth** in sockets in the jaw.

Orders.—There are about 3000 kinds of Mammals, and these are arranged in orders. (See p. 234).

VERTEBRATA, CLASS II.—BIRDS (pp. 25–31).

Characteristics:

1. The **second** class of the Vertebrata in order of development.
2. The **covering** always consists of *feathers*.
3. The **young** are hatched from *eggs*.
4. The **head** is *singly-jointed* with the backbone.
5. The **heart** is *four-chambered*; the **blood** *warmer* than in Mammals.
6. The **chest** (thorax) and **belly** (abdomen) are not separated by a *diaphragm*.
7. **Breathing** is effected by *lungs* and *air-sacs*.
8. The **thorax** is bounded by *ribs*.
9. The regular number of **limbs** is four: viz. a pair of legs and a pair of wings.
10. There are no **teeth**, but some birds have gizzards.

Orders.—Birds differ greatly in the structure of their bills and toes. These differences enable us to group them into orders. (See p. 234.)

VERTEBRATA, CLASS III.—REPTILES (pp. 31–36).

Characteristics:

1. The **third** class of the Vertebrata in order of development.
2. The **covering** consists of horny *scales* or *plates*.
3. The **young** are hatched from *eggs*.
4. The **head** is *singly-jointed* to the backbone.
5. The **heart** is *three-chambered*; the **blood** is *cold*.
6. The **chest** (thorax) and **belly** (abdomen) are not separated by a *diaphragm*.
7. **Breathing** is effected by *lungs*.
8. The **thorax** is bounded by *ribs* (generally).
9. The **limbs** are absent or four in number (generally).
10. The Tortoises and Turtles have a horny beak, and no teeth. The other reptiles have **teeth**, but these are not sunk in separate sockets, except in the Crocodiles.

Orders.—(See p. 234.)

VERTEBRATA, CLASS IV.—AMPHIBIANS (pp. 36-39).

Characteristics:

1. The **fourth** class of the Vertebrata in order of development.
2. The **covering** generally consists of *soft moist skin*.
3. The **young** are hatched from *eggs*, but undergo a later metamorphosis.
4. The **head** is *doubly-jointed* with the backbone.
5. The **heart** is *two-chambered* in the young; *three-chambered* in the adult. The **blood** is *cold*.
6. The **chest** (thorax) and **belly** (abdomen) are not separated by a *diaphragm*.
7. **Breathing** is carried on by means of *gills* in early life, and by *lungs* at a later period.
8. The **thorax** is bounded by *ribs* (generally).
9. The **limbs** are never converted into fins, as in Fishes.
10. There are **teeth** generally.

Orders.—(See p. 234.)

VERTEBRATA, CLASS V.—FISHES (pp. 39-46).

Characteristics:

1. The **fifth** and lowest class of the Vertebrata in order of development.
2. The **covering** is of *scales*.
3. The **young** are hatched from *eggs*.
4. The **head** is *singly-jointed* to the backbone.
5. The **heart** is *two-chambered*, and the **blood** *cold*.
6. The **chest** (thorax) and **belly** (abdomen) are not separated by a *diaphragm*.
7. **Breathing** is effected by *gills* during the whole lifetime.
8. The **thorax** is not bounded by the *ribs*.
9. The **limbs** take the form of *fins*, but there are generally other fins as well.
10. They have **teeth**.

DIFFERENCES BETWEEN CLASSES IV. AND V.

| AMPHIBIANS. | FISHES. |
|--|--|
| 1. Have lungs at adult stage. | 1. Never have lungs . |
| 2. Limbs are not converted into fins. | 2. Fins, instead of limbs proper. |
| 3. The heart is three-chambered (in the adult). | 3. The heart is two-chambered. |
| 4. They undergo metamorphosis . | 4. They do <i>not</i> undergo metamorphosis. |

Kinds.—For chief orders see p. 234.

INSECTS (pp. 46-52).

Structure.—The body is divided into three distinct parts:

1. **Head**; bearing the eyes, feelers, and jaws.
2. **Thorax** (or chest); formed of three segments, and bearing three pairs of legs, and two pairs of wings (generally).
3. **Abdomen** (or belly); having a varying number of segments, and without legs or wings.

Breathing.—Insects have neither gills nor lungs. They breathe by means of tubes, which open in the sides of the body.

Metamorphosis.—By this is meant the great changes that most insects undergo before they reach a perfect state.

Some insects have three stages of development, viz.:

1. The *grub*, *caterpillar*, or *maggot* stage; in which eating is almost the only kind of work done.
2. The *chrysalis* or *pupa* stage; in which the grub goes into a cocoon of its own making, and rests for a time.
3. The *perfect insect* or *imago* stage; in which the insect has its complete form. In this stage the female lays eggs, from which the grubs (or caterpillars or maggots) emerge in due time.

Uses of Insects:

1. Bees make wax and honey.
2. Insects fertilize flowers (*e.g.* bees, &c.).
3. They clear up decaying matter (*e.g.* beetles).
4. They loosen and stir the soil (*e.g.* ants).
5. The caterpillar of the silk moth spins silk.

Insects as Pests:

1. Insects destroy or disturb roots of plants.
2. They feed on leaves or juices of plants.
3. The grubs bore into stems and roots.
4. Insects eat the wood of houses and furniture.
5. They plague domestic animals.

PART II.—PLANT LIFE.

THE PARTS OF A FLOWER (p. 53).

A complete flower has—

1. **Sepals**; which form the *calyx*.
2. **Petals**; which form the *corolla*.
3. **Stamens**; which have *anthers*, containing *pollen*.

4. **Pistil**; consisting of (a) the *stigma*.
 (b) the *style*.
 (c) the *ovary*, which holds *ovules* or seed-buds.

The sepals and the petals form protective coverings for the inner parts of the flower.

Some flowers have neither petals nor sepals, as the coco.

FERTILIZATION.—FLOWERS AND SEEDS (pp. 56–65).

Fertilization.—The ovules in the ovary (at the bottom of the pistil) do not begin to develop into seeds until the stigma receives some pollen-grains from the anthers. When this occurs the flower is *fertilized*. It may be—

- (a) **Self-fertilized**, by pollen-grains from the same flowers.
 (b) **Cross-fertilized**, by pollen-grains from another flower of the same kind.

Self-fertilization is impossible in some flowers, because—

1. The flower may not have both stamens and pistil; or
2. The anthers may scatter their pollen before the stigma is ready for it; or
3. The structure of the flower prevents it.

Cross-fertilization.—Pollen is carried from one flower to another by—

1. The wind; or by
2. Insects and small birds.

Wind-fertilized flowers are generally small, and without gay colours or sweet juices. Their anthers are long and open to the breeze; their stigmas large or feathery, to catch the wind-borne pollen.

The colour and odour of flowers serve to attract insects, &c.

GERMINATION.—SEEDS AND SEEDLINGS (pp. 65–67)

The Seed.—Each seed contains—

1. The **germ** of a new plant.
2. A store of **food**.

When the germ begins to grow the seed is said to **germinate**.

The Germ.—This consists of—

1. **Radicle**, or beginning of the root.
2. **Plumule**, or bud.
3. Either one seed-leaf (as in corn), or two seed-leaves (as in a pea).

The Store of Food may be either—

1. In the seed-leaves (as in peas), or

2. Outside and around the germ (as in corn, cocoa-nut, and coffee).

In the former case the young plant forms the entire kernel of the seed; in the latter it forms only a small portion of it.

Conditions.—In order to germinate, a seed must have—

1. **Moisture**; which causes the seed to swell and to burst its skin.
2. **Warmth**; some seeds require much greater warmth than others
3. **Air**; from which the seed obtains oxygen gas.

HOW A PLANT FEEDS (pp. 68-74).

Plant-food is derived from—

1. The **Air**; through the leaves and green stems.
2. **Water**; through the leaves, stems, and roots.
3. The **Soil**; through the roots.

From the atmosphere and water plants can obtain oxygen, hydrogen, carbon, and some nitrogen. The rest of the nitrogen required, and all the mineral substances, are taken from the soil.

Water consists of **oxygen** and **hydrogen**.

The air consists mainly of **oxygen** and **nitrogen**. In it are small quantities of—

1. Carbonic-acid gas, containing *oxygen* and *carbon*; and
2. Ammonia and nitric acid, containing *nitrogen* and *hydrogen*.

The Roots.—Numbers of the cells of the root-fibres lengthen out like hairs. These root-hairs absorb water and dissolved plant-food.

The Leaves:

1. They **feed** on the carbonic acid, nitric acid, and ammonia of the air.
2. They keep the carbon of the carbonic acid, and give out the oxygen (*assimilation*).
3. They **breathe** (*respiration*); that is, they take in oxygen and give out carbonic acid, though the latter is much less in quantity than the oxygen given out in sunlight.
4. They give off water (*transpiration*).

HOW PLANTS ARE REARED (pp. 74-79).

Plants may be reared by various means, viz.—

1. By **Seeds**. We should select the *finest* seeds from the *best* plants.
2. By **Bulbs**; *e.g.* onions.
3. By **Tubers**; *e.g.* yams.
4. By **Runners**; having a bud at the end of a slender stem.
5. By **Suckers**; or shoots from underground stems, as in bananas
6. By **Buds**; as in the root-stock of ginger.

7. By **Cuttings**; as in sugar-cane.

This plan is of special value, because the qualities of the parent plant will be maintained by the new one.

8. By **Layers**. In layering we only *partly* separate the cutting until it has rooted.

9. By **Budding**. } Buds or cuttings are set in the stem of an old plant

10. By **Grafting**. } or tree instead of in the ground.

These young growths will come into bearing earlier than if they had to start life as independent plants.

HOW SOILS ARE FORMED (p. 80).

Origin.—Soils are formed naturally by—

1. The rocks breaking up and crumbling; or by
2. The remains of plants and animals.

Forces at Work.—The forces which act upon the rocks are—

1. **Water:**

It softens or dissolves portions of the rock.

It carries into the rocks the gases the rain gathers from the atmosphere.

It distributes and mixes the crumbled soil.

The waves and the running streams wear down the rocks and soil.

2. **The Atmosphere:**

(1) By chemical changes due to the gases.

(2) By the force of the winds.

3. **Changes of Temperature:**

(1) Intense heat with drought causes the land to crack.

(2) Intense cold causes water to freeze, whereby rocks are split and soil crumbled; also, rocks are ground down by moving masses of ice (*glaciers*).

4. **Vegetation:**

(1) The roots give out an acid which dissolves portions of the soil, and thus loosens other portions. They also grow into crevices, and wedge pieces of rock or soil away.

(2) Plants add to the soil by their decay.

KINDS OF SOIL (p. 83).

Soils are composed of—

Sand; which consists of little grains of a glassy substance, called *quartz* or *silica*.

Clay; which consists of *silica* and *alumina*. When dry it can be crushed into fine powder, and when wet it clings together in a stiff and sticky mass.

Lime. This is generally found combined with carbonic acid, and is then called *carbonate of lime*; chalk, limestone, marble, shells, and coral, are all various forms of this substance.

Humus, or vegetable soil, formed by the decay of plants. It is of a dark colour, and is even black sometimes.

Soils composed almost entirely of decayed vegetable matter are known as **peat**. All fertile soils have some humus in them.

Mixed Soils.—In describing a mixed soil we consider the proportions of sand and of clay in it.

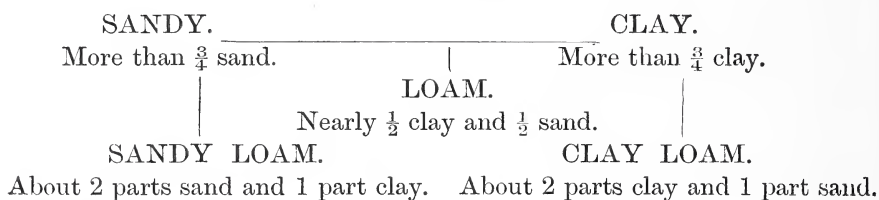
Loam has about equal parts of clay and sand.

In a **sandy loam** the sand exceeds the clay, and in a **clayey loam** the clay exceeds the sand.

A **marl** soil has lime in it.

A **chalky** soil is more than one-fifth lime.

The classification is shown in the diagram.



Descriptions of Soils.—Soils may also be described thus—

Alluvial; if laid down by water.

Local; if it has been formed where it is found.

Transported; if it has been carried to a distance by wind or water.

Surface Soil; top soil.

Subsoil; underlying the surface soil.

Heavy or **Stiff**; a clayey soil, which is “heavy” or “stiff” to work.

Light or **Free**; a sandy soil, which is “light” or “free” to work.

MORE ABOUT THE SOIL (p. 87).

Plant-food.—The plant-food in the soil may be—

1. **Active**; being soluble in rain-water; or
2. **Dormant**, *i.e.* “sleeping”; being insoluble in rain-water, and unable to feed the crops.

Moisture.—All soils hold moisture, though not in the same degree.

Water drains downwards through the soil; it also rises as the surface-soil dries.

TILLAGE (p. 89).

The object of tillage is to increase the fertility of the soil. This it does in the following ways—

1. It prevents hardening of surface, and lets in air and water.

2. It exposes the undersoil to the atmosphere, by which dormant plant food becomes active.
3. It mixes the soils.
4. It keeps soil open and porous, thus allowing the passage of the air and the young roots.
5. It aids the capillary movement of water upwards in time of drought.
6. It frees the ground of weeds.

DRAINAGE (p. 92).

Necessity for Drainage:

1. To get rid of excess of water.
2. To make room for air to enter the soil.
3. To allow the soil to get warmed by the sun.
4. To wash out sour and poisonous matter.

Methods of Drainage:

1. By trenches.
2. By pipes or tiles laid underground.

HOW WE ROB THE SOIL (p. 95).

Exhaustion.—Plants sort out from the soil the plant-food they need. In time the “active” plant-food required is used up. Then the land is “sick” or “exhausted”.

Remedies:

1. **Rest** for the soil. Then some of the store of dormant plant-food will become active. This is why land is often left “ruinate”.
2. **Change** or rotation of crops.
3. **Manures**, to add to the supply of active plant-food.
4. **Good tillage**.

HOW WE HELP TO FEED THE PLANTS (p. 99-101).

Uses of Manure:

1. To prevent exhaustion of soil by—
 - (a) Adding plant-food.
 - (b) Acting on the dormant food.
2. To restore fertility of exhausted soils.
3. To supply necessary plant-food that is deficient in the soil.
4. To improve texture by—
 - (a) Loosening heavy soils.
 - (b) Binding light soils.

Kinds of Manure:

1. **General**; viz. "green" manure, and pen or "farmyard" manure.
2. **Special**; to supply some particular need, *e.g.* guano, crushed bones, wood ashes, &c.

CLIMATE AND PLANT LIFE (p. 101).

The growth of plants is dependent upon climate.

Plants differ in the amount of light, heat, and moisture they require.

They are affected by—

1. The warmth of the air.
2. The moisture in the air.
3. The direction and force of the winds.
4. The amount of rainfall.
5. The amount of sunshine.

INSECT PESTS (p. 103).

The insect pests are numerous both in kind and in number. They mostly attack weakly plants, and therefore a healthy growth should be kept up. Among the chief pests are—

Caterpillars, Grubs, and Maggots; the larvæ hatched from eggs of beetles, moths, butterflies, and other insects.

Examples. The "grugru" or palm-grub, sugar-cane borer, coffee-leaf miner, tobacco-leaf "worms".

Injuries. Green parts of plants are eaten; or roots, stem, seeds, &c., are bored.

Remedies. Picking off by hand. Destroying the perfect insect.

Scale-insects.—Of these about 500 varieties exist.

Injuries. They weaken the plant by sucking its juices.

Remedy. Syringing with solution of soap.

Natural Enemies. Number of insect pests are taken for food by other creatures, *e.g.* by birds, lizards, scorpions, centipedes, and spiders, and by other insects.

Ticks upon Animals.—Ticks from diseased animals often cause the disease in other animals. Their young ones are equally harmful. Withered grasses and vegetable refuse harbour them. Animals should be kept free from ticks, and tick-destroying birds should be protected.

PART III.—CULTIVATION OF CROPS.

SUGAR (pp. 107-112).

Soils and Situation.—A hot, moist climate and well-drained soil containing lime are suitable.

Propagation.—By cuttings (usually called “plants”), set out 5 or 6 feet apart.

Work to be Done.—Ploughing or hoeing, to loosen soil and admit air and water.

Burying weeds for green manure.

Planting out.

Weeding, while the plants are young.

Light ploughing between rows, to let air into the soil.

Trashing (except in dry weather), to allow air to circulate.

Cutting. This takes place twelve or fourteen months after planting.

Ratoons.—The stools or root-stocks left in the ground will send up fresh canes called ratoons. But a new supply of canes is desirable after the fifth year.

The Sugar.—To obtain the sugar the following processes are necessary—

1. **Crushing** the cane, to obtain the juice.
2. **Clarifying** the juice, by adding lime and heating.
3. **Defecating**; removing the scum.
4. **Boiling**; to form a syrup by driving off the water.
5. **Striking**; passing it into flat, open coolers.
6. **Granulating**; the grains form as the syrup cools.
7. **Clearing from molasses**; by draining, or by the action of centrifugals.

Rum.—This “spirit” is obtained by *distillation* after the liquid has *fermented*.

Fermentation. Molasses, skimmings, water, and dunder are mixed and left to ferment, which causes the liquid to undergo a great change.

Distillation. Vapour is driven off from the liquid by *heat*, and is then condensed by *cold*. The new liquid formed by the condensation is rum.

COFFEE (pp. 113-117).

Soil and Situation.—The long tap-root requires a deep soil, not clayey. Arabian coffee grows at elevations of from 2500 to 5000 feet. Liberian coffee does best in lowlands.

Propagation.—By seeds, which are sown in nursery beds, bamboo pots, or “at stake”.

Planting.—The land should be—

1. **Lined**, at distances of from 5 to 10 feet; and
2. **Holed**.

The seedlings should be—

1. Set out in wet weather.
2. Shaded for a few days.
3. Watered, unless rain be plentiful.

Shading.—By bananas, congo peas, or other shade plants.

Topping.—When from 3 to 5 feet high the main stem should be topped. This is done—

1. To prevent damage by winds.
2. To encourage the spread of branches.
3. To allow the berries to be easily gathered.

Pruning.—To let in light and air.

Manuring:

1. Mulching with pen-manure, or with weeds and trash.
2. Burying rotted manure.

Pests.—Mealy-bug, borer, scale-insects, coffee-leaf miner, rats and mice.

THE COFFEE BEANS (p. 117).

Preparation:

1. **Pulping**; by means of a machine called a “pulper”.
2. **Fermenting** and **Washing**; to cleanse the beans.
3. **Drying**. The beans are then known as “parchment” coffee.
4. **Milling**; to remove parchment and silver-skin.
5. **Winnowing**; to blow away the broken skins.

Dry-berry Coffee.—Sometimes the berries are dried instead of being pulped, and are shipped off in a dry state.

THE BANANA (p. 120).

Soil.—The best soil for bananas is a loam with lime in it, and a good supply of humus. For example:—

| | | |
|-------------------|---|---------------|
| 40 parts of clay, | } | in 100 parts. |
| 3 parts of lime, | | |
| 5 parts of humus, | | |
| 52 parts of sand, | | |

Cultivation.—**Suckers** are cut from the underground stem, and planted 14 or 15 feet apart. Allow three suckers of different stages to grow for fruiting. Keep the ground well weeded, ploughed, and harrowed. Root out the stool after a few years and put a fresh one near its place. Bananas are good shade-plants for young cocoa-trees.

Gathering.—Cut the fruit a week or more before it would become ripe, and avoid bruising. Chop the stem into short lengths for manure.

THE COCOA-NUT PALM (p. 122).

Soil and Situation.—The cocoa-nut palm thrives near the sea, in (a) alluvial soils near mouths of rivers; (b) deep loam; or (c) sandy coast soils.

Propagation.—Ripe nuts are sown in nursery beds. Seedlings (about six months old) are planted out 25 or 30 feet apart, after the ground has been *holed*. Much water is needful, therefore *irrigation* is often beneficial.

Pests:

1. **Scale-insects.** The leaves attacked should be burnt, or cleansed with kerosine, soap, and water.
2. **Beetle-grub**, in the bud. This should be found and killed.
3. **Rats.**

The Produce.—Fruit is ready in the fifth or sixth year. Trees continue bearing for many years.

1. **The Nuts.** These are valuable for—

- (a) Food.
- (b) Their oil (used in making soap, candles, &c.).
- (c) Cattle food. For this the pieces of kernel (called *poonac*) are serviceable, after the oil has been pressed out.

2. **The Coir.** The fibres, after being separated and cleaned by machinery, are sorted into—

- (a) "Bristle" or "brush fibre".
- (b) "Mat fibre".
- (c) Rough or refuse fibre.

TOBACCO (p. 124).

Soil.—A rich soil is necessary; clays and chalky soils are unsuitable.

Propagation.—From seed; sown in August or September.

Work to be done:

1. Ploughing deeply, and harrowing.
2. Furrows to be made three feet apart for the rows of plants.

3. Planting out, when the seedlings are about six weeks old.
4. Watering in dry weather.
5. Moulding up the plants.
6. Constant weeding.
7. Topping to destroy the flower-bud.
8. "Suckering" (disbudding), to remove side-shoots.
9. "Worming" daily, to destroy caterpillars.
10. Harvesting. The plants are cut down when ripe, and, when withered, are carried to the drying-house.

Curing.—Leaves are stripped from the midrib, and placed evenly in heaps to allow of *fermentation*, which goes on for 30 or 40 days. The "cured" leaves are tied up into bundles, called "hands", for exportation.

LOGWOOD (p. 128).

Soil.—A moist soil, rich in humus, is best. Heavy clay soil or loose sand is unsuitable.

Cultivation.—The land should be holed at distances of 15 feet, and seedlings transplanted in wet weather. Care should be taken that these are raised from the seeds of mature trees. Other useful operations are— weeding; pruning off side-shoots and suckers, to strengthen growth of stem; sawing off lower branches, to obtain straight trunks.

The Logs.—These are cut about 3 feet long. They show (1) light sap-wood, which has to be chipped off; (2) heavy, dark-coloured heart-wood, which is exported, and yields a valuable dye.

CORN (p. 131).

Soil and Situation.—The best soil is a deep sandy-loam, well drained. In the West Indies a suitable climate for corn is found in situations between 200 and 900 feet above sea-level.

Cultivation:

1. Ploughing and hoeing, and turning up subsoil.
2. Lining the land into 3 feet squares.
3. Sowing seeds at the corners of the squares.
4. Dressing top-soil with lime or wood-ashes is beneficial.
5. Moulding up, to bring soil near the roots growing from the lower joints.
6. Clearing off tops, after the pollen is shed.
7. Stripping off leaves when seeds are ripening.
8. Harvesting; cutting, drying, and shelling.

COCOES (p. 134).

Description.—Cocoas (called in some parts *eddoes*, or *tanias*) are from the tuberous root-stock of the coco plant (*Colocasia*).

The **leaves** are net-veined, unlike nearly all those of other plants with one seed-leaf.

The **inflorescence**, or flower-spike, has male flowers on the upper part and female flowers below. These have neither sepals nor petals.

Soil.—The most suitable is a sandy loam, very moist, and rich in humus.

The usual work of ploughing, harrowing, and lining is needful.

Propagation.—The head of the root-stock, when buried, throws out a number of shoots. These may be separated, and planted a yard apart.

Uses:

1. The tubers; for food.

They consist chiefly of starch.

2. The leaves; for fodder.

3. The plants; for shade.
-

PART IV.—HEALTH.

WHY WE EAT (p. 136).

The Body and its Work.—The body is built up of various substances, such as bones, fat, muscles, tendons, nerves, and blood. The materials of which these are formed are supplied by the carbon, oxygen, nitrogen, hydrogen, sulphur, phosphorus, and other elements which are in our foods.

Necessity for Food.—To supply material for:

1. The growth of the body.
2. The repair of the tissues.
3. Producing warmth and strength.

Kinds of Foods.—Foods may be classed according to:

1. Their **source**, into Animal, Vegetable, and Mineral Foods.
2. Their **state**, into Solids, Liquids, and Gases.
3. Their **composition**, into *Nitrogenous* (Flesh Formers); containing nitrogen. *Carbonaceous* (Heat Givers); without nitrogen, and containing a large proportion of carbon. *Mineral*; such as water, salt, lime, &c.

HEAT-GIVING FOODS (p. 140).

Heat of the Body.—The temperature of the body in health is the same at all seasons and in all climates, and is about 98° F. The heat of the body is constantly passing away, and the loss must be made good.

Maintenance of Heat.—The body gains heat by the oxidation (or burning) of food material.

The chief **heat-givers** in our foods are:

(1) Starches; (2) sugars; and (3) fats.

These are made up of oxygen, hydrogen, and carbon, and are often called **Carbonaceous Foods**.

Starch is found in *plants*. It is plentiful in the seeds of all kinds of corn-grasses; in yams, sago, arrowroot, &c.; and in leaves. It is formed in little grains, which are of different sizes and shapes in different plants. Starchy foods are most used where they are most common in nature—that is, in warm climates. In cold climates, where vegetable food cannot be had in abundance, the fats of animals serve as heat-giving food.

The **Sugars** are also mostly obtained from *plants*; but *milk*, too, has some sugar in it.

The **Fats and Oils**.—At the ordinary temperature of the air fats are solid and oils liquid. They may be found in (a) in *plants*; e.g. palm-oil, olive-oil, cocoa-nut-oil, cocoa-butter. Or (b) in *animals*; e.g. the fat of meat, suet, the oil in fish.

FLESH-FORMING FOODS (p. 144).

Flesh-formers contain *Nitrogen*, as well as Carbon, Hydrogen, and Oxygen, and are therefore sometimes called **Nitrogenous Foods**. They are also known as **Proteids**.

The chief flesh-formers in our foods are:

1. **Albumen**; in the white of egg, in blood, in juices of meat, &c.
2. **Casein**; in the curd of milk, &c.
3. **Fibrin**; in the blood.
4. **Gluten**; in corn and other grain.
5. **Legumin**; in peas and beans.
6. **Gelatin**; in the bones of animals.

Flesh-formers are digested in the stomach. They then enter the blood, and are carried by it to build up the body in its growth, and to repair waste.

A FEW COMMON FOODS (p. 147).

Vegetable Foods:

1. **Corn**. Besides containing a large amount of starch, corn is rich in fatty matter, and also has gluten. It is therefore both a heat-giver and a flesh-former. Out of 100 parts in corn, 64 are starch, 9 gluten, and 5 fat. *Corn-flour* is the starch of the corn.

2. **Roots and Tubers**; such as *yams*, *cocoas*, *sweet-potatoes*. These contain great quantities of starch, with a small share of flesh-forming material.

The following foods consist almost wholly of starch, viz.:—*Arrowroot*, *tapioca*, *sago*, *corn-flour*.

3. **Pulses.** The chief pulses are beans, peas, and lentils. These are rich in nitrogenous or flesh-forming food.

4. **Fruits.** (1) *The Banana.* About three-fourths of the ripe fruit consist of *water*; the remainder is chiefly *sugar*, with a little *gluten*.

The banana, though valuable in hot countries, is not of itself a perfect food, because of its short supply of flesh-forming material. It requires the addition of such food as meat, pulse, or fish.

(2) *The Bread Fruit*, when unripe, contains much starch, which, as the fruit ripens, changes into sugar.

That *fruits*, like tubers, hold a great quantity of water, may be seen from the following figures:—

| | | | | | | |
|--------|-----|-----|-------|-------|----|------|
| Rice | has | 14½ | parts | water | in | 100. |
| Corn | ,, | 15 | ,, | ,, | ,, | 100 |
| Banana | ,, | 74 | ,, | ,, | ,, | 100. |
| Yam | ,, | 80 | ,, | ,, | ,, | 100. |

Animal Foods.—These include the flesh of animals, birds, fishes, &c.; also milk and eggs. They are nitrogenous, or contain flesh-forming material.

As a rule animal foods are *sooner digested* than vegetable foods; are more *appetizing*; and, bulk for bulk, more *nutritious*.

Milk is a “model food”, containing in proper proportions all the substances required both for building up the body, and for keeping up its heat and strength.

Milk is made up of about 87 parts in the hundred of water, about 3 of fat (butter cream), about 4½ of casein, and a little more of milk-sugar, the rest being different salts

Therefore, milk is a **carbonaceous**, a **nitrogenous**, and a **mineral** food.

Mineral Foods.—The chief (besides *water*) are:

Salt.

Lime; in hard water, and in milk, meat, &c.

Potash; in fresh vegetables and fruits.

Iron; in most foods.

Sulphur; in the yolk of eggs, &c.

THE BEST KIND OF DIET (p. 150).

Necessity for a Mixed Diet.—This necessity may be thus illustrated. Coccoes or bananas are an excellent food, but if used alone as a diet we should require to eat large quantities daily, to get as much **nitrogenous** material as we require to rebuild waste. But we should then eat much more **carbonaceous** material than we require. And the unnecessary carbonaceous, or starchy matter, would thus be wasted, and would do us harm before we got rid of it. But cocoes with meat or fish would give us what we require if we consumed a smaller quantity of the mixed food than of the cocoes alone.

WATER.—I. (p. 153).

Hard and Soft Water.—Spring water is usually *hard* owing to the lime and other mineral substances it contains. Rain water is *soft*.

Hard water curdles soap, and does not make soap-suds, and so is not suitable for washing. If lime in the water be the cause of the *hardness*, boiling will get rid of it, and deposit it on the sides of the boiler, which is then said to be *furred*.

Animal and Vegetable Impurities:

1. Water that runs over the surface of the land takes up impurities from the decaying vegetation, or from the refuse of houses, cattle-pens, &c.

2. Or it may be fouled by sewage or house refuse draining into the soil.

Sources of Water-supply:

- | | |
|--|------------------------|
| 1. Spring water. | } Generally wholesome. |
| 2. Deep well water. | |
| 3. Upland surface water. | |
| 4. Lake water. | |
| 5. Stored rain water. | } Doubtful. |
| 6. Surface water from cultivated land. | |
| 7. River water contaminated with sewage. | } Dangerous. |
| 8. Shallow well water, or pond water. | |

Storage of Water.—Cisterns used for storing water should be regularly cleaned.

Materials for Cisterns:

Slate is the best.

Stone or brick (lined with *cement*) is good.

Galvanized iron; also good.

Wood is bad.

WATER.—II. (p. 156).

Water is present in all foods:

1. In **beverages**, where it forms by far the largest part of the bulk; as coffee, milk, &c.

2. In **solid foods**. Thus out of 100 parts we have 74 parts water in bananas, nearly 80 in fish, about 70 in lean meat, 50 in fat, 15 in corn-meal, and 80 in yam.

Water in the Body.—Being thus present in foods, water is also present in the body, which is built up from foods.

Thus, bone contains over 80 per cent of water; muscle, 75 per cent; blood and nerve matter, nearly 80 per cent.

In addition, large quantities of water pass through the body from the kidneys, skin, and lungs.

Functions of Water.—The work done by water in the body is as follows:

1. It **softens** foods.
2. It **dissolves** foods.
3. It keeps the **blood** constantly and uniformly **fluid**.
4. It makes **secretions** (tears, &c.).
5. It **carries off waste matter** through the kidneys, the pores of the skin, and the breath.
6. It has a **cooling effect** when taken into the body.
7. By producing perspiration it **keeps down the heat** of the body so that it is regulated to about 98° F.

Impure Water.—Water fouled with the decaying remains of plants or animals is unfit for drinking, and may cause illness. It should be *boiled* and *filtered* if there is any doubt of the purity.

The presence of this harmful matter in water may be detected by adding a few drops of Condyl's Fluid, which will tinge it with pink. If the water be foul, the pink colour will rapidly change.

OTHER BEVERAGES (p. 160).

Their Preparation.—Various drinks are prepared by means of water and substances obtained from plants. They are either:

1. **Infusions**; such as coffee, chocolate, tea, tamarind water, cocoa-nut water, &c.
2. Water **flavoured** with the juices of fruits, as lime-juice.
3. **Fermented liquors**, such as rum and other alcoholic beverages.

Coffee.—Coffee contains a substance called **caffeine** (like *theine* in tea), which stimulates the nervous system.

The effects of coffee are:

1. To increase the action of the heart and lungs.
2. To delay the digestion of meat foods
3. To increase the activity of the brain.
4. To decrease perspiration.

Cocoa or Chocolate is:

1. **Nourishing**, on account of the flesh-forming substance in it.
2. **Fattening**, from the fatty water.
3. **Nerve-restoring**, from the *theobromine* (similar to theine or caffeine).
4. Very palatable.

Alcoholic Drinks.—These are quite unnecessary for people in health. If used too freely they cause great mischief to the organs of the body.

WHAT BECOMES OF OUR FOOD (p. 163).

Process of Digestion.—Digestion is carried on in the mouth, the stomach, and the small intestine.

1. **The mouth.** The *teeth* masticate, or crush the food. The *saliva* moistens it, and turns part of the *starch* (which is insoluble) into *sugar* (which is soluble). From the mouth the food passes by the *gullet* into—

2. **The stomach.** Here the *gastric juice* acts on the nitrogenous part of the food. The digested food passes into the small blood-vessels in the wall of the stomach. The rest of the food passes on into—

3. **The small intestine.** Here two juices pour in, namely the *bile* and the *pancreatic juice*. These dissolve the fats, and the latter also completes the digestion of the starch and nitrogenous foods. The nourishing part of the foods then pass into the blood through the small vessels of the intestines.

THE AIR WE BREATHE (p. 166).

Composition of Air.—Air is a mixture of several gases, of which the chief are **nitrogen** and **oxygen**. Small proportions of carbonic acid gas, ammonia, and other gases are also present, and vapour.

Oxygen is without colour, taste, or smell. It is the most abundant of all the elements in nature. Substances that burn in air burn much more rapidly in oxygen.

Nitrogen is also colourless, and without taste or smell. It will neither burn nor cause other substances to burn. By its presence in the air it modifies the action of the oxygen.

Carbonic acid gas is without colour or smell, but has a slight acid taste. It is a heavy gas, and will not support life.

Carbonic Acid Gas.—The carbonic acid gas in the air is thus *produced*:

1. By the **breathing** of all animals.

The air that is breathed out contains more carbonic acid and water vapour than that which is breathed into the lungs.

The skin also gives off carbonic acid gas and water.

2. By **combustion**.

3. By the **decay** of vegetable and animal remains.

Carbonic acid gas is *removed from* the air by plants, which in sunlight absorb it and give out oxygen. The fall of rain also removes a little of the carbonic acid gas, as well as solid impurities.

WHY THE WIND BLOWS (p. 169).

Movements of the Air.—The land, after being warmed by the sun, gives out warmth to the air that is in contact with it. Heated air expands, and thus any given volume of air will not always have the same weight, but will become lighter as it grows warm. Being lighter it rises,

and the colder and heavier air rushes into its place. Thus a *wind* is caused.

Land and Sea Breezes.—These winds are due to the fact that land takes in heat, and also gives it out, more quickly than the sea does. Therefore, by *day* the land becomes hotter, and at *night* colder, than the sea.

VENTILATION (p. 171).

Reasons for Ventilation.—The air of a room is made impure by the waste matters passing off by the breath and the skin of persons in it.

The changes in the composition of the air due to breathing (respiration) may be thus shown. In 10,000 parts of air there are :

| | As it enters the lungs. | | As it leaves the lungs. |
|--------------------------|----------------------------|-------|----------------------------|
| Nitrogen, | 7900 | | 7900 |
| Oxygen, | 2096 | | 1630 |
| Carbonic acid gas, | 4 | | 470 |
| | <hr/> 10,000 | | <hr/> 10,000 |

How to Ventilate.—We must have an *outlet* for the foul air and an *inlet* for the fresh air, so as to keep the air moving. Draughts should be avoided; also the entry of malarial air.

Ventilation may be provided by means of :

1. Doorways, windows, or other openings.
2. Special apparatus; such as tubes, gratings, &c.
3. A space under the ground floor, where the air may circulate, so that harmful gases from the soil do not rise into the house.

THE CLOTHES WE WEAR (p. 174).

Uses of Clothing:

1. To help to maintain an even temperature in every part of the body.
2. To shield the body from the scorching rays of the sun.
3. To absorb the perspiration.
4. To keep the body from being wetted by rain or dew.
5. To protect the skin from being torn or injured.

Clothing should be:

1. A bad conductor of heat; that is, it should not readily lead (or conduct) the heat of the body away.
2. Porous; to allow impurities from the skin to pass through it.
3. Absorbent; to suck up the perspiration and pass it outwards to the air.
4. Not heavy.

5. Light in colour in warm countries; that it may absorb as little as possible of the sun's heat.

6. Of easy fit; that it may not by pressure check the circulation of the blood, or prevent free movement of the body.

Materials for Clothing:

Wool. Woollen goods are of various kinds—as flannels, worsted, cashmere, merino, &c. They are excellent for clothing because they are bad conductors of heat, and thus prevent its escape from the body. They are also light, of open texture, absorbent, and durable.

Silk is a good material for hot climates, but is expensive.

Furs are suitable for cold climates. Air being a bad conductor of heat, those materials are warmest that have much air in their meshes; such as furs, feathers, and loose wool.

Cotton. Cotton material is not equal to woollen for absorbing moisture, and for checking the escape of heat from the body; but it is cheaper, and is light.

Linen is made from the fibres of the flax plant. It is less useful than cotton or wool.

Leather, the tanned skins of animals, is strong and durable; it bends easily, and keeps out the wet. It is therefore the best covering for the feet.

WHERE TO LIVE (pp. 178-183).

The situation of a house has a great effect upon the health of its inmates. In choosing a site the following points should be borne in mind:—

1. The site should be dry. Low-lying ground at the foot of a hill is undesirable. Not only is it damp, but it receives the drainage of the higher ground.

2. The site should be well drained. For this reason a hillside is a good site.

3. A soil of gravel, chalk, or sand is good, because water drains away freely through it. If, however, such a soil receives the drainage from higher lands it may become saturated, and therefore unsuitable.

4. "Made" soils are bad, because of the harmful gases that will arise from decaying animal or vegetable matter in them.

5. The site should be airy. Ravines should be avoided.

6. It should not be closely surrounded by bush, or overhung by trees.

PART V.—GOVERNMENT.

WHY LAWS ARE MADE (p. 184).

Laws are **necessary** to provide for:

1. The safety and welfare of the people, and
2. The protection of property.

Jamaica is a part of the British Empire. The various parts of the empire have their own laws, but all are under the dominion of one sovereign.

THE LEGISLATIVE COUNCIL OF JAMAICA (p. 186).

Forms of Government.—Since 1655, when Jamaica became part of the British empire, there have been four forms of government in the island, viz.:

1. **Military rule**; for a few years.
2. **General Assemblies**; from 1664 to 1866.
3. **Crown Government**; 1866 to 1884. During this time the people had no voice in the election of the governing council.
4. **A Legislative Council**; since 1884. Some of the members of the council are elected by the people.

The Legislative Council consists of:

Fourteen members elected by the parishes, and seven official members.

The **Official Members** are:

The Chief Military Officer in Jamaica.

The Colonial Secretary.

The Attorney-General.

The Director of Public Works.

The Collector-General.

And two gentlemen nominated by the Governor.

The council is elected for five years; it meets at Head-Quarter House, in Kingston.

THE GOVERNOR (p. 188).

His Majesty's representative is "The Captain-General and Governor-in-Chief of Jamaica".

His Excellency is appointed for six years, and resides at King's House.

He is assisted by a **Privy Council**, consisting of:

The Senior Military Officer.

The Colonial Secretary.

The Attorney-General.

And three members approved by the King.

GOVERNMENT IN THE PARISHES (p. 191).

Parishes.—Jamaica is divided into three **counties**, which are further divided into fourteen **parishes**.

| County of Surrey. | County of Middlesex. | County of Cornwall. |
|-------------------|----------------------|---------------------|
| Kingston. | St. Catherine. | St. Elizabeth. |
| St. Andrew. | St. Mary. | Trelawny. |
| St. Thomas. | Clarendon. | St. James. |
| Portland. | St. Ann. | Hanover. |
| | Manchester. | Westmoreland. |

Parochial Board.—A Board is elected in each parish for three years for the management of local affairs.

The **Duties of the Board** include:

- (a) Levying rates for poor relief, sanitary purposes, and general purposes.
- (b) Maintaining roads other than the main roads.
- (c) Attending to conditions of health.
- (d) Providing markets, water-supply, &c.

PUBLIC DEPARTMENTS AND OFFICES (p. 192-197).

The **Duties** of a government are:

1. **Legislative**; or the making of laws.
2. **Administrative**; or carrying out the laws.
3. **Judicial**; or enforcing obedience to the laws, and the punishment of offenders.

Departments.—These duties are carried out by various departments, of which the chief (in Jamaica) are:

1. The Colonial Secretary's Office.
2. The Public Works Department.
3. The Treasury Department.
4. The Customs, Excise, and Inland Revenue.
5. The Post-Office Department.
6. The Judicial and Legal Department.
7. The Police Department.
8. The Education Department.
9. The Government Medical Service.
10. The Public Gardens and Plantations Departments, &c.

THE COURTS OF JUSTICE (p. 197).

For the administration of justice we have:

1. The Supreme Court.

2. The Circuit Courts.
3. The Resident Magistrates' Courts.
4. The Courts of Petty Sessions.

The **Supreme Court** consists of three judges, one of whom is styled the Chief Justice. This court "holds session" at Kingston at least six times a year.

A **Circuit Court** is held by one of the Judges of the Supreme Court in the principal town of each parish three times a year. The cases are heard before a jury.

A **Resident Magistrate** is appointed for each parish.

Courts of Petty Sessions are held for the trial of minor offences, by gentlemen who have been appointed "Justices of the Peace".

PUBLIC GARDENS AND PLANTATIONS (p. 199).

Duties.—The Department intrusted with the control of the Public Gardens and Plantations undertakes the following duties:

1. To introduce and propagate useful plants.
2. To give information as to the methods of cultivation.
3. To distribute seeds and plants.

The **Public Gardens** in the charge of this Department are:

1. The Botanic Gardens, Castleton.
2. Hill Gardens and Government Cinchona Plantations.
3. Hope Garden.
4. Kingston Parade.
5. Botanic Gardens at Bath.
6. King's House Gardens and Grounds.

ARMY, NAVY, AND VOLUNTEERS (p. 203).

Army.—About 1500 soldiers are generally on duty in Jamaica. Their barracks are at:

1. Newcastle, for the British troops.
2. Up Park Camp, for one battalion of the West India Regiment.
3. Port Royal, for detachments of Artillery and Engineers.

Navy.—Halifax, in Nova Scotia, is the *head-quarters* of the squadron for North America and the West Indies. A man-of-war usually lies off Port Royal, and a guard-ship is stationed there. The town has a *dock-yard*.

Volunteer Militia.—This force was formed in 1885. It consists of men who have joined of their own free will.

GENERAL VIEW OF THE ANIMAL KINGDOM.

(Referring mainly to types and orders mentioned in this book.)

SUB-KINGDOM I.—VERTEBRATA.

| <i>Class.</i> | <i>Order.</i> | <i>Types.</i> |
|----------------------------------|------------------------------|--|
| Mammalia (Mammals), | Primates, | Man and Monkeys. |
| | Carnivora (Flesh-eaters), | Seals, Walruses (water animals). Bears (sole-walkers). Cats, Dogs, &c. (toe-walkers). |
| | Insectivora (Insect-eaters), | Shrews, Moles, Hedgehogs, &c. |
| | Chiroptera (Hand-winged), | Bats. |
| | Rodentia (Gnawers), | Rats and Mice; Hares and Rabbits. |
| | Ungulata (Hoofed), | Horses, Mules, Asses (odd-toed). Oxen, Sheep, Camel (even-toed). |
| | Sirenia (Sea cows), | Manatees. |
| | Cetacea, | Whales and Dolphins. |
| | Edentata (Toothless), | Sloths, Armadillos. |
| Aves (Birds), | Marsupialia (Pouched), | Kangaroos (in Australia); Oposums (in America). |
| | Raptores (Birds of Prey), | Eagles, Vultures, Owls, Falcons, Buzzards. |
| | Insessores (Perchers), | Finches (cone-beaked); Thrushes, Tits, Warblers (tooth-billed); Humming Birds (long-beaked). |
| | Scansores (Climbers), | Woodpeckers, Parrots, Macaws, &c. |
| | Rasores (Scratchers), | Fowls, Quails, Pigeons. |
| | Grallatores (Waders), | Hérons, Plovers, Sandpipers. |
| | Natatores (Swimmers), | Gulls, Pelicans, Frigate-birds, Ducks, Geese, &c. |
| Reptilia (Reptiles), | Chelonia, | Tortoises and Turtles. |
| | Ophidia, | Snakes. |
| | Lacertilia, | Lizards. |
| | Crocodilia, | Crocodiles and Alligators. |
| Amphibia (Amphibians), | Anoura (Tail-less), | Frogs and Toads. |
| | Urodela (Tailed), | Salamanders. |
| Pisces (Fishes), | With Bony Skeleton, | Eels, Cod, Salmon, &c. |
| | With Cartilage, | Sharks, Rays. |

SUB-KINGDOM II.—MOLLUSCA.

Soft-bodied animals; *e.g.* Oysters, Snails, Cuttle-fish.

SUB-KINGDOM III.—ANNULOSA.

Division 1. **Anarthropoda** (without jointed limbs); *e.g.* Earthworms.

2. **Arthropoda** (with limbs jointed to the body); includes:

Class, *Crustacea*—Crabs and Lobsters.

„ *Arachnida*—Spiders, Scorpions, Ticks.

„ *Myriapoda*—Centipedes.

„ *Insecta*—Beetles, Flies, Butterflies, &c.

SUB-KINGDOM IV.—ANNULOIDA.

Includes Sea-urchins, Star-fishes, &c.

SUB-KINGDOM V.—CŒLENTERA'IA.

Includes Jelly-fishes, Sea-anemones, Corals, &c.

SUB-KINGDOM VI.—PROTOZOA.

Includes Sponges, &c.

LIST OF THE MORE DIFFICULT WORDS AND PHRASES.

PART I.

Page. Par.

- 9, 2. **museum** ; a place for storing collections of objects.
 „ 3. **cabinets** ; furniture fitted with drawers, &c.
 „ 4. **specimens** ; objects which serve as examples.
 14, 4. **corals** ; consisting of a chalky substance, and formed in the sea
 by minute animals.
 18, 7. **correspond** ; agree.
 21, 3. **erect** ; upright.
 24, 9. **finally** ; lastly.
 „ „ **disport themselves** ; move playfully.
 25, 2. **we distinguish them** ; we note or recognize how they differ
 from others.
 26, 4. **air-sacs** ; cells containing air.
 „ 5. **compact** ; closely arranged.
 28, 5. **familiar** ; well known.
 31, 10. **disgorge** ; to cast up from the stomach.
 33, 7. **the circulation of the blood** ; the regular passage of the
 blood through the arteries and veins.
 36, 12. **its victims** ; the animals that it kills.
 38, 4. **dissolve** ; to change from a solid to a fluid state.
 „ 7. **peculiar** ; of singular or uncommon appearance.
 40, 4. **suffocated** ; killed by being unable to breathe.
 42, 9. **purify it** ; to make it pure.
 44, 4. **lagoons** ; shallow pools.
 46, 9. **distinct from** ; different from.
 51, 7. **hitherto** ; up to the present time.
 52, 8. **in structure** ; in form and build.

PART II.

- 55, 7. **quicken** ; start into life or growth.
 58, 5. **proboscis** ; the horny tube with which insects suck the juices
 of plants or animals.
 „ „ **apparently motionless** ; seeming to be without movement.
 „ „ **poised** ; balanced.

Page Par.

- 61, 8. **fertilizing grains**; the grains (of pollen) that cause fruitfulness.
- 63, 5. **radicle**; the minute root of a plant in its earliest growth.
- 64, 7. **offspring**; the descendants.
- 70, 9. **vapour**; the gaseous form of water.
- 71, 11. **pores in the leaves**; small openings called *stomata*.
- 74, 2. **multiply its kind**; increase the number of its kind.
- 77, 1. **suckers**; shoots from an underground stem.
- 79, 8. **securely**; safely.
- 80, 3. **particles**; minute pieces.
- „ 4. **Arctic regions**; the parts of the world lying around the north pole.
- 84, 1. **fertile soil**; soil good for the growth of plants.
- 93, 3. **sodden**; soaked with water.
- 94, 5. **stagnant**; without movement; impure from the want of motion.
- 96, 4. **exhausted**; having the contents used up.
- 98, 12. **restored**; brought back.
- „ „ **fertility**; a fertile or fruitful state.
- 99, 3. **nitrogen**; one of the gases in the atmosphere.
- 101, 2. **tropical lands**; lands in the hottest parts of the earth.
- „ 3. **equator**; an imaginary line round the earth midway between the poles.
- „ 4. **no control**; no power of management.
- 102, 6. **regulated**; controlled.
- „ 8. **dry regions**; districts that have little rain.
- 103, 4. **tunnel**; a place hollowed out to form a passage.

PART III.

- 109, 5. **specially made**; made for a particular purpose.
- 110, 2. **a triangle**; of three-sided form.
- 111, 4. **exposed**; uncovered or unprotected.
- „ 5. **similarly**; in like manner.
- 116, 2. **mulched the ground**; spread a layer over it.
- 120, 1. **productive**; yielding fruit plentifully.
- 121, 5. **irrigate**; to water the land by flooding it with water conveyed in trenches.
- 122, 1. **alluvial soil**; soil laid down by running water.
- 123, 6. **detect**; discover.
- „ „ **fronds**; the foliage of ferns and palms.

Page Par.

- 123, 6. **kerosene**; an oil prepared from petroleum.
 124, 7. **the coir**; the fibres of the cocoa-nut husk.
 126, 6. **disbudding**; clearing off buds or young shoots.
 128, 12. **to ferment**; to undergo chemical changes within its substance.
 „ 2. **turmeric**; a plant of the ginger family, which yields a yellow dye.
 134, 2. **extensively**; widely, largely.

PART IV.

- 138, 9. **repaired**; restored to a sound or good state.
 „ „ **desert**; a barren tract of land.
 142, 2. **charred**; partially burnt.
 144, 12. **digested**; dissolved and made ready to pass into the blood.
 145, 2. **combined**; united to form a compound.
 146, 7. **nourishing the body**; feeding it, and causing proper growth.
 147, 2. **material**; the substance or matter of which anything is made.
 149, 8. **invalids**; persons who are weak and unwell.
 150, 12. **a “model diet”**; a kind of course of food that may serve as an example.
 151, 5. **polar regions**; the districts around the north and south poles; the coldest parts of the world.
 152, 7. **the exact proportion**; in the right or proper shares.
 154, 3. **impurities**; foul substances.
 155, 6. **fouled**; made impure.
 „ „ **refuse**; waste matter.
 156, 8. **porous**; having minute openings into which water can pass.
 159, 7. **filtered**; purified by draining through a filter.
 160, 9. **malarial fevers**; fevers caused by the foul air or water from marshy districts.
 „ 2. **capering**; skipping or jumping in frolic.
 161, 4. **stimulate**; to enliven or rouse.
 162, 11. **alcohol**; a liquid obtained by distilling; sometimes called “spirit of wine”.
 163, 2. **saliva**; a fluid sent out by glands in the mouth.
 165, 7. **pancreas**; an organ of the body, which secretes the pancreatic juice.
 167, 5. **a large proportion**; a large share.
 168, 9. **direction of the wind**; the quarter from whence the wind blows.
 169, 11. **numberless specks**; small portions too numerous to reckon.

Page Par.

- 169, 2. **the same proportion**; a share that does not vary.
 „ 4. **expand**; to spread out or enlarge.
 172, 3. **pores**; small openings in a solid body.
 174, 2. **thermometer**; an instrument for marking the degree of heat.
 „ „ **temperature**; the degree of heat.
 177, 10. **perspiration**; the moisture given off through the skin.
 „ „ **expensive**; costly.
 178, 13. **absorb**; to draw or suck in.
 „ 2. **torrid zone**; the part of the world between the tropics of Cancer and Capricorn; the hottest part of the world.
 179, 4. **trade winds**; regular winds which blow over a space of about 30 degrees on each side of the equator.
 „ 6. **site**; situation or position.
 180, 11. **malarious**; giving off unhealthy gases, which cause fever.

PART V.

- 185, 3. **prosperous**; thriving.
 „ 4. **prevail**; to have influence, or to overrule.
 „ „ **under such conditions**; in such circumstances.
 186, 2. **elected**; chosen.
 187, 5. **recommendation**; the act of bringing into notice one who is likely to be of service.
 190, 4. **officials**; gentlemen holding an office or position of trust.
 191, 3. **parochial**; belonging to a parish.
 192, 5. **to dissolve it**; to deprive it of authority, and to cause the members to abandon their office.
 194, 6. **hindrance**; that which hinders or causes delay.
 195, 7. **Treasury**; a place where public money is managed and paid out.
 „ „ **thrifty**; of careful and saving habits.
 „ 1. **Postmaster-General**; the person who is at the head of the postal affairs.
 196, 4. **customs**; the “duties” or payments fixed by law on certain goods imported or exported.
 „ „ **revenue**; the annual income of a state or government.
 197, 5. **agriculture**; the art of cultivating the ground.
 198, 4. **Coroner**; an officer of the Crown, appointed to inquire into cases of sudden death.
 „ 5. **supreme**; the chief or highest in authority.
 „ 6. **arson**; the act of wilfully setting fire to property.

Page Par.

199, 7. **accused person**; one who is charged with an offence.

202, 8. **tropical plants**; plants that thrive in the hot climate of the tropics.

203, 10. **parade**; a public walk or promenade.

„ 11. **beautifies**; makes beautiful.

„ 1. **regiment**; a body of soldiers. The army is divided into regiments.

„ „ **gallant**; brave.

205, 3. **battalion**; a division of a regiment.

„ „ **barracks**; a large building for soldiers to live together in.

„ 5. **pennant**; a small flag.

„ „ **squadron**; a number of ships of war.

„ 9. **volunteers**; persons who enter into military or other service without payment.

